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Testing Motors. THE old saying, that it is the little things that tell, finds no better illustion than that contained in the valuable article by Mr. F. B. Crocker, on the testing of small motors. While the design of a motor, whether large or small, and its construction, may be ever so carefully carried out, it is only by a thorough test that its actual qualities can be determined. The result of such intelligent work in small motors, in which Messrs. Crocker and Wheeler are among the pioneers, has been to close the wide gap, which has always been deemed insurmountable, between the efficiency of small and large prime movers of all types; so that in this respect the electric motor to-day presents the best example of a prime mover in that the smallest can be operated at nearly the same efficiency as the largest. When we consider the large number of small motors in operation to-day, and their universal application in the future, this valuable property has a most important bearing.

Regulating the Telegraphs. ONCE more the idea of regulating the telegraphs on the "interstate commerce" plan has been brought before Congress, and Mr. Spooner has a bill in the Senate on the subject, following familiar lines. To the proposed Interstate Commerce Commission is given jurisdiction over telegraph companies, and the business transacted thereby, and it is furnished with ample powers. As we have before said on the subject, there is something to be urged for the supervision—and much against it; but it is decidedly preferable to any government control of the telegraphs.

Running by Electric Motor. ABOUT a year ago we mentioned the fact that one make alone of electric motors was employed in 125 industries in this country. Since then the number has been largely increased, and every day grows bigger. It is, in fact, difficult to find an industry for which, where power is used under a system of distribution, the electric motor is not eminently qualified. A striking little instance of its versatility has just been recorded in Minneapolis, where the motor not only runs the sewing machines in an overalls factory, but does all the cutting. More than this, the current warms the irons that do the pressing on the goods.

Insulating Staples. PROBABLY as much mischief has been done in the past in wiring with metal staples as fastenings as from any other cause, and we dare say every practical electrician will be able to recall instances in support of this assertion. It is pleasant to believe, therefore, that the electrical constructor is now placed in possession of such an insulating staple, note of which we make, that even with careless workmen he will not find all his pains and expense in providing a highly insulated wire vitiated by a few careless strokes of a hammer. Though a seemingly small detail, the new staple will without doubt command the attention which it merits.

Improvements in Insulation. WHETHER the mode of distribution be one of high or of low tension, the question of insulation remains an all important one, and any advance in this direction deserves special recognition. We have already recorded with pleasure the advent of the new method of running electric wires within "interior conduits" in buildings, and, after again witnessing the experiments made with the conduit, are more than ever convinced that it meets fully the demands made upon it. The description of these tests, which we give elsewhere, shows that the tubing combines admirably the qualities of a fireproof and waterproof material.

An Interesting Career. NOT a few of the electricians of note in America are of European birth, and their presence and prosperity in this country may well be taken as an indication both of the hearty, free-handed reception given here to genius and enterprise and of the manifold opportunities presented by the rapid development of electricity. We are confident that the career of Mr. Nikola Tesla, narrated in this issue, will interest our readers greatly, as that of a typical newcomer, who has brought with him the highest qualities and who seeks to make in his work the fullest return for the generosity and appreciation of his American brethren in the electrical field. So far as that work has gone, it has been of singular importance, and it is impossible to deny the fact that Mr. Tesla has led the way into one of the most fruitful and promising departments of electrical research and application that has been opened up these ten years.

The Cause of the Tracy Fire. THE whole world was horrified last week by the news of the destruction by fire of Secretary Tracy's house in Washington, and the consequent death of the wife and daughter of that official, he himself barely escaping with his life. The local inspector has reported that the fire was due to gas from a Bunsen burner, and there are traces of such an origin. But another investigation is also said to have shown that it resulted from overheated steam pipes. In either case very little note is made of the origin of the fire. But how if it had been due to an electric wire, or there had been a rumor that it might be an electric wire? We undertake to say, without fear of contradiction, that the papers would have devoted ten columns to the subject where they gave one, and that their wild, irresponsible talk would have given another setback to the electric-lighting industry, against which the struggle must have been once more made by those who know how senseless and malicious the attack has been.

Dry Batteries. THE impartial discussion of the properties of any device or invention can never be amiss if thereby the advantages and disadvantages are brought out in their proper light. The number of dry batteries which have of late been brought out, therefore, makes the present an eminently timely season to institute a comparison between them and the general type of fluid batteries. This comparison is taken up by Mr. John A. Barrett, whose large experience in this direction entitles his conclusions to more than ordinary consideration. As Mr. Barrett points out, there is no essential difference in the voltaic actions going on in a dry battery and in a fluid, but the construction of the former necessarily limits its effectiveness in more than one direction. Mr. Barrett does not deny that, like everything else, dry batteries have a distinct place in electrical work, which cannot be filled so well by the fluid batteries, but he deprecates the attempts which are being made to apply them to work for which they are not fitted, and which must lead to disappointment and loss in the end.

Electrical Deaths. So many wild statements have been published by the daily press regarding the alleged sufferings of the few unfortunates who have met their death by coming in contact with electric wires, that a trustworthy discussion of the subject will be a relief from the vagaries to which the public has been treated. Prof. E. J. Houston, who has made electro-physiology a special study, shows that muscular contraction may occur long after physiological death has taken place, and that probably in most cases the convulsive twitchings noticed after the first shock are unaccompanied by any sensation of suffering. One of the best proofs of this, as cited, is the well-known Galvani experiment with the legs of a frog, in which convulsive action is maintained long after physical death has ensued.

Electric Railway Power Station. EVENTS even of the greatest importance are slow in making their effects felt, but one would be lacking in discernment if he did not perceive the effect which the construction of the large power station of the West End Street Railroad Company, in Boston, will have in increasing the already immense impetus which the electric railway has received. Having even now in operation probably the largest power station in the world, the West End Company are so well convinced of the success of their undertaking that their new station will be equipped to develop nearly 20,000 horse power. Our extended description of this new station on another page will give the reader a good idea of the many improvements which it is proposed to introduce, and which will reduce the cost of power to a minimum. As will be noted, the new type of four-pole Thomson-Houston dynamo will be employed, each capable of generating 200 electrical horse-power and running at a reduced speed, due to the increased number of poles. The work is in good hands and will certainly mark an epoch in electric railway annals.

Courting Investigation. A MAN whose record is clean never fears investigation, though he may, perhaps, find it necessary now and then to be alert to protect himself from trickery and chicanery. So, too, with newer industries, such as the various applications of electricity. Their record for good, and for public benefit conferred, is so indisputable that they have nothing to dread but the misrepresentation of their foes; and hence it is that electricians are so ready for a showing of the facts in the case. We are very glad to see that Mr. A. J. De Camp, of Philadelphia, whom we all know to be one of the most public-spirited men in the electric light field, has circulated a petition asking Congress to appropriate the small sum of $50,000 for the purpose of investigating the industry, not only with a view of ascertaining the figures that represent its growth, but specially with the object of inquiring into the casualties that have resulted from the use of electric currents, and as compared with casualties from other agents employed for similar purposes. This is a timely appeal and deserves the full support of the convention this week at Kansas City, as well as of all who are interested in electrical development. It shows, at any rate, that electric light men have no fear of the results. They need have none. There is no other industry in the world in which so much energy is used with so much good and so little harm.

Long Distance-Power Transmission. IN the interesting paper read by Mr. E. A. Sperry before the Chicago Electric Club, the author discussed principally the question of the relative advantages of long-distance electric power transmission with the constant current and constant potential. So far as Mr. Sperry's figures go as to the difference in cost of the dynamos for such purpose, no fault can be found in his argument; but we think that an important point has been lost sight of which ought to be considered, and which involves the nature of the work. Thus, if it were a question of conveying a certain power to a single point at a distance where it is to be applied almost directly on the spot, there would be no serious objection to the constant current method of transmission. But, on the other hand, if the problem involved a *distribution* of power to a large number of consumers at the distant end, the advantages of the constant potential method would seem to favor the latter. The difficulties to be contended with in a constant current method of distribution were, we think, very clearly and fairly set forth in one of our recent issues, and although they are probably avoidable, they are only made so at a sacrifice to some extent of simplicity. No one will deny that the automatic constant potential motor presents less complications and hence requires less care and attention than the constant current motor with its accompanying governor. That both types of machine will operate satisfactorily has been too long demonstrated to require any exemplification at this time, but we think that the question, which to employ in a given case, is not so much one of choice as of adaptation to existing and constraining circumstances.

ELECTRICAL WORLD PORTRAITS.—XII.

NIKOLA TESLA.

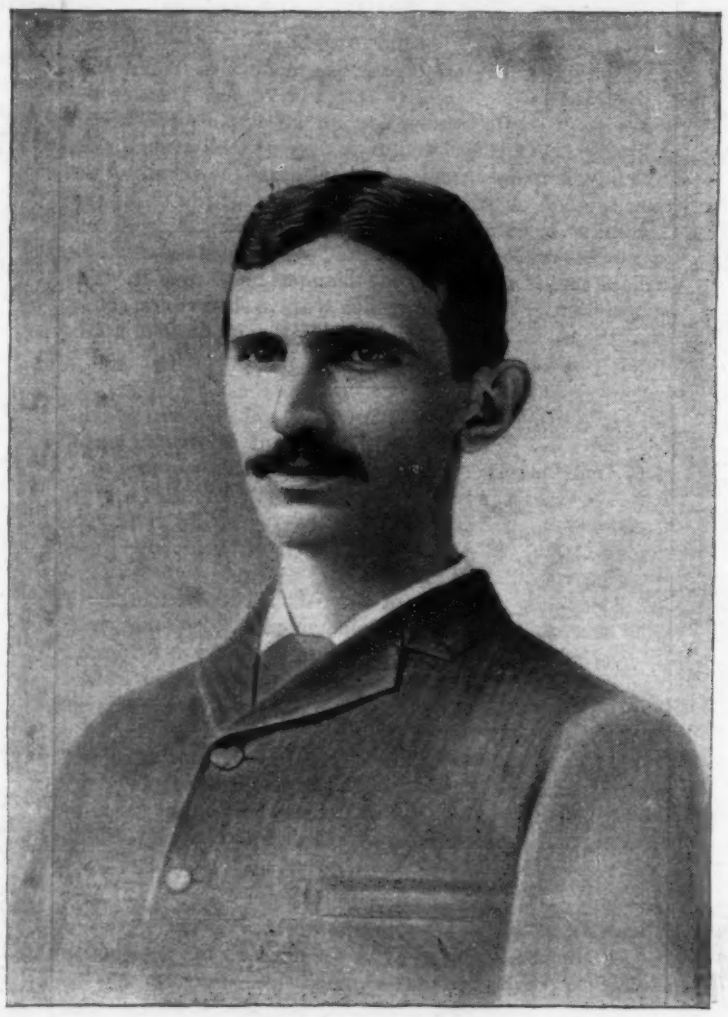
While a large portion of the European family has been surging westward during the last three or four hundred years, settling the vast continents of America, another, but smaller, portion has been doing frontier work in the Old World, protecting the rear by beating back the "unspeakable Turk" and reclaiming gradually the fair lands that endure the curse of Mohammedan rule. For a long time the Slav people—who, after the battle of Kosovopjolje, in which the Turks defeated the Servians, retired to the confines of the present Montenegro, Dalmatia, Herzegovina and Bosnia and "Borderland" of Austria—knew what it was to deal, as our Western pioneers did, with foes ceaselessly fretting against their frontier; and the races of these countries through their strenuous struggle against the armies of the Crescent, have developed notable qualities of bravery and sagacity, while maintaining a patriotism and independence unsurpassed in any other nation.

It was in this interesting border region and from among these valiant Eastern folk that Nikola Tesla was born; and the fact that he, to-day, finds himself in America and is one of our foremost electricians is striking evidence of the extraordinary attractiveness alike of electrical pursuits and of the country where electricity enjoys its widest application.

Mr. Tesla's native place was Smiljan, Lika, where his father was an eloquent clergyman of the Greek Church, in which, by the way, his family is still prominently represented. His mother enjoyed great fame throughout the country-side for her skill and originality in needlework, and doubtless transmitted her ingenuity to Nikola; though it naturally took another and more masculine direction.

The boy was early put to his books, and upon his father's removal to Gospic he spent four years in the public school, and, later, three years in the Real School, as it is called. His escapades were such as most quickwitted boys go through, although he varied the programme on one occasion by getting imprisoned in a remote mountain chapel, rarely visited for service; and on another occasion by falling headlong into a huge kettle of boiling milk, just drawn from the paternal herds. A third curious episode was that connected with his efforts to fly; when, attempting to navigate the air with the aid of an old umbrella, he had, as might be expected, a very bad fall, and was laid up for six weeks.

About this period he began to take delight in arithmetic and physics. One queer notion he had was to work out everything by three or the powers of three. He would also calculate the cubes of every article of food put on the table at meals, and when in the streets would count every pace. He was now sent to an aunt at Carlstatt, Croatia, to finish his studies in what is known as the Higher Real School. It was there that, coming from rural fastnesses, he saw a steam engine for the first time, with a pleasure that he remembers to this day. At Carlstatt he was so d igent as to compress the four years course in three, and graduated in 1873. Returning home during an epidemic of cholera, he was stricken down by the disease, and suffered so seriously from the consequences that his studies were interrupted for fully two years. But the time was not wasted, for he had become passionately fond of experimenting, and, as much as his means and leisure permitted, devoted his energies to electrical study and investigation. Up to this period it had been his father's intention to make a priest of him, and the idea hung over the young physicist like a very sword of Damocles. Finally he prevailed upon his worthy but reluctant sire to send him to Gratz, in Austria, to finish his studies at the Polytechnic School, and to prepare for work as professor of mathematics and physics. At Gratz he saw and operated a Gramme machine for the first time, and was so struck with the objections to the use of commutators and brushes that he made up his mind there and then to remedy that defect in dynamo-electric machines. In the second year of his course he abandoned the intention of becoming a teacher and took up the engineering curriculum. After three years of absence he returned home, sadly, to see his father die; but, having resolved to settle down in Austria, and recognizing the value of linguistic acquirements, he went to Prague and then to Buda-Pesth, with the view of mastering the languages he deemed necessary. Up to this time he had never realized the enormous sacrifices that his parents had made in promoting his education, but he now began to feel the pinch, and to grow unfamiliar with the image of Francis Joseph the First. There was considerable lag between his dispatches and the corresponding remittances from home; and when the mathematical expression for the value of the lag assumed the shape of an eight laid flat on its back, Mr. Tesla became a very fair example of high thinking and plain living; but he made up his mind to the struggle, and determined to go through depending solely on his own resources. Not desiring the fame of a faster, he cast about for a livelihood, and through the help of friends he secured a berth as assistant in the engineering department of the government telegraphs. The salary was five dollars a week. This brought him into direct contact with practical electrical work and ideas, but it is needless to say that his means did not admit of much experimenting. By the time he had extracted several hundred thousand square and cube roots for the public benefit, the limitations, financial and otherwise, of the position had become painfully apparent, and he concluded that the best thing to do was to make a valuable invention. He proceeded at once to make inventions, but their value was visible only to the eye of faith, and they brought no grist to the mill. Just at this time the telephone made its appearance in Hungary, and the success of that great invention determined his career, hopeless as the profession had thus far seemed to him. He associated himself at once with telephonic work, and made various telephonic inventions, including an operative repeater; but it did not take him long to discover that, being so remote from the scenes of electrical activity, he was apt to spend time on aims and results already reached by others, and to lose touch. Longing for new opportunities and anxious for the development of which he felt himself possible, if once he could place himself within the genial and direct influences of the gulf streams of electrical thought, he broke away from the ties and traditions of the past, and in 1881 made his way to Paris. Arrived in that city, the ardent young Likan obtained employment as an electrical engineer with one of the largest electric lighting companies.



NIKOLA TESLA.

The next year he went to Strasburg to install a plant, and on returning to Paris sought to carry out a number of ideas that had now ripened into inventions. About this time, however, the remarkable progress of America in electrical industry attracted his attention, and, once again staking everything on a single throw, he crossed the Atlantic.

Mr. Tesla buckled down to work as soon as he landed on these shores, put his best thought and skill into it, and soon saw openings for his talent. In a short while a proposition was made to him to start his own company, and, accepting the terms, he at once worked up a practical system of arc lighting, as well as a potential method of dynamo regulation, which in one form is now known as the "third brush regulation." He also devised a thermomagnetic motor and other kindred devices, about which little has yet been published, owing to legal complications. Early in 1887 the Tesla Electric Company of New York was formed, and not long after that Mr. Tesla produced his admirable and epoch-marking motors for alternating current, in which, going back to his ideas of long ago, he evolved machines having neither commutator nor brushes. It will be remembered that about the time that Mr. Tesla brought his motors out and read his thoughtful paper before the American Institute of Electrical Engineers, Prof. Ferraris, in Europe, published his discovery of principles analogous to those enunciated by Mr. Tesla. We may, therefore, mention the fact, as additional evidence of Mr. Tesla's priority in this field, that some months before Mr. Tesla read his paper we were cognizant of his new work, and that we had ourselves the pleasure of seeing his motors in successful operation several weeks before that memorable meeting in May at which his paper was read. His inventions, however, we believe, far antedate even that period.

Mr. Tesla's work in this field was wonderfully timely, and its worth was promptly appreciated in various quarters. The Tesla patents were acquired by the Westinghouse interests, and at the present time the Tesla alternating current motor is being applied by the Westinghouse Electric Company to work of different kinds. A week or two ago we illustrated its use in mining, and its employment in printing, ventilation, etc., has already been shown in our columns.

The immense stimulus that the announcement of Mr. Tesla's work gave to the study of alternating current motors would in itself be enough to stamp him as a leader; but from what we know of him, we do not hesitate to predict that this is not at all the only work by which he will be known and remembered.

Mr. Tesla is only 33 years of age. He is tall and spare, with a clean-cut, thin, refined face, and eyes that recall all the stories one has read of keeness of vision and phenomenal ability to see through things. He is an omnivorous reader, who never forgets; and he possesses the peculiar facility in languages that enables the educated native of eastern Europe to talk and write in at least half a dozen tongues. A more congenial companion cannot be desired for the hours when one "pours out heart affluence in discursive talk," and when the conversation, dealing at first with things near at hand and next to us, reaches out and rises to the greater questions of life, and duty, and destiny.

A Good Record from the Reading, Pa., Electric Road.

The electrical and technical papers of the country have devoted considerable attention, as our readers are well aware, to the scientific aspects of electric railroading. New types and styles of motors have been treated thoroughly in this paper, and all improvements which have been made in electric street railway science have received due recognition.

In this discussion of the technical aspects of electrical street railroading, the commercial side has been in a measure overlooked, although this is the one which concerns particularly the street railway manager. An electric railway, no matter how scientifically or how carefully it has been built, will not be used unless its use gives actual returns to the investors. Under these circumstances it is particularly interesting to note that electric railways have been a success in a commercial aspect and that the records show that capital invested in electric railways is sure to be remunerative when ordinary care and judgment are taken in its investment.

The report of the East Reading Electric Railway and Motor Company for the year 1889 emphasizes the fact that electric railways are a commercial success, and that even during the first year of their operation they show gratifying financial results.

This road was installed a little more than a year ago upon the Sprague system, and although its location is not particularly advantageous, the results have been extremely gratifying. The number of cars equipped is four, and the annual report of the treasurer, issued Jan. 1, 1890, shows that dividends at the rate of 8 per cent. per annum upon the working capital were paid, besides leaving a large balance in the treasury. Another interesting fact in connection with this report is that it shows that during the last year the number of passengers carried was more than double the entire population of Reading. Nothing can more convincingly show the popularity of electric railway motor power. The operating expenses during that time were $4,380.81, or about 2.6 cents per passenger carried.

While the economic advantages of the use of electricity are not so pronounced on such a small road as upon a line operating a greater number of cars, these results are very gratifying to all interested in electric traction, and we congratulate the Sprague Electric Railway and Motor Company for the excellent showing of this road, equipped upon its system.

Reorganization of the Baxter Motor Interests.

The Baxter Electric Motor Company, of Baltimore, has just been incorporated as the successor of the Baxter Electric Manufacturing and Motor Company of Baltimore, whose property and assets it has purchased.

Its board of directors embraces some of Baltimore's wealthiest, as well as most successful business men, one of whom, Mr. Edward G. Hight, is its president, which fact and its having secured the services of Mr. David E. Evans to place the company on a proper manufacturing basis, together with its assured strong financial backing is a

guarantee that the interests of the company will be properly guarded.

The Baxter motor is too well known throughout the country to need further public notice, and a number of new and valuable inventions covering the whole range of power plant will be at once placed before the electrical interests of the country. Among the specialties will be their electrical elevator (passenger and freight); generator with running outfit complete; street railway motors and car trucks.

The immense shops in East Baltimore will be reopened, and a full force of skilled mechanics employed, so that no delay will occur in filling orders from old or new correspondents. The company asks that inquiries be at once instituted by all interested in electric power matters, so that the new management may be afforded an opportunity of making good its claims to support and patronage.

Electric Phenomena of the Heart.

A special meeting of the Berlin Physiological Society was called by Prof. Dubois-Reymond on December 27, in order to see a demonstration, by Dr. Augustus Waller, on man and other animals, of the electromotive action accompanying the beat of the heart. Besides the ordinary members of the society, the leading physicists of Berlin were invited, and Profs. Helmholtz and Kundt witnessed the experiments. Dr. Waller employed the capillary electrometer, the indications being magnified 1,250 times and thrown on a ground glass screen in one of the lecture-rooms of the Physiological Institute, and demonstrated the electromotive action of the heart in a horse and in a dog. The horse stood in a court-yard near the lecture room; electrodes were attached to his extremities by firm bands, and the wires from the electrodes were passed through the window to the electrometer in the preparation room adjoining the lecture room. The dog stood in the lecture room. In the library of the Institute, Professor Dubois-Reymond allowed the demonstration to be made on himself, so that the pulsations might be seen directly through the microscope by all the members present. Dr. Waller's work in this direction is well known and formed the subject of his introductory address delivered at St. Mary's Hospital at the opening of the session 1888–89. A Montyon Prize was afterward awarded to him in Paris for his investigations.

The New St. Louis Westinghouse Station.

The new station of the Missouri Electric Light and Power Company, of St. Louis, Mo., has recently gone into operation, and presents a good example of solid construction, both within the station and in the outside work.

The company was organized and the order placed on Feb. 19, 1889; on July 6 the station was partly started, and on Jan. 1, 1890—that is, practically within ten months—it had 22,467 lamps of 16 c. p. connected.

The company owns a lot situated between Nineteenth and Twentieth streets, on Locust street, 170 by 80 feet. Of this lot only 75 feet by 155 feet is actually covered by buildings devoted to electric lighting machinery. The boiler room, which is shown in the accompanying engraving, Fig. 1, contains six Babcock & Wilcox boilers, having an aggregate steaming capacity of 1,800 horse-power. Each boiler is connected with a Roney mechanical stoker, and the coal is elevated into tanks situated above the boilers, and from there is fed automatically into the stokers. The pressure carried is 125 pounds.

The exhaust steam from the engines is led through two Berryman feed water heaters, and the pumping machinery is all in duplicate. The stack is made on the plan of the Pennsylvania furnaces, of ⅜-inch tank iron, 8 feet 3 inches internal diameter, and 137 feet high.

The engine room contains six Westinghouse vertical compound engines, having 16 by 27-inch cylinders and 16 inches stroke; each of these, as shown, is belted directly to a 3,000 light dynamo of the Westinghouse pattern. The engines are, in practice, found to develop a horse-power for $22\frac{4}{10}$ pounds of steam of 125 pounds pressure per indicated horse power.

The switchboard, which is shown in Fig. 1, is entirely novel in its construction, being practically fire-proof and very much simpler in its construction than those heretofore used in similar stations. Wires connect it with the dynamos underground, and lead off with sixteen distinct feeders, which are so connected that all, or any one of them, can be operated from any single dynamo. It takes about twelve seconds to throw six feeders from one dynamo on to another, the operator simultaneously keeping the pressure constant by the use of Stilwell regulators. Each feeder is provided with a full set of standard Westinghouse compensating and regulating appliances. The exciters are in duplicate, either one of them being large enough to operate eight No. 3 (3,000-light) dynamos, and are worked by two separate 30 h. p. engines.

The station, as laid off, is operated by one chief engineer who does not stand watch; two engineers and two oilers serve in the engine room, while two firemen and three helpers work the boiler room. One steam fitter is kept in charge of the general maintenance and repairing of steam pipes, boilers, etc., making a total staff of eleven men to operate a station having a generating capacity of 18,000 lamps of 16 c. p., and nearly 23,000 lamps actually connected.

The station is operated entirely on the meter system, over 370 meters being in use. Up to date, that is, during six months' actual service, only three meters have been found to require attention. They are of the Shallenberger pattern, as manufactured by the Westinghouse Electric Company. The rates charged are 1¼ cent per lamp per hour, with a variable discount according to whether it is for residences, business offices or wholesale consumers.

In the lines, Simplex wire has been used almost exclusively. In view of the fact that they aggregate over 250 miles, it was deemed advisable to use the very best insulating material, and the results fully justify the choice. During the violent sleet and snow storms at the beginning of this year, not a single wire was pulled down, or a single line dangerously grounded, although nearly 900 wires of other companies fell on to these lines.

The light has generally been adopted in business blocks and residences, the proportion of customers belonging to

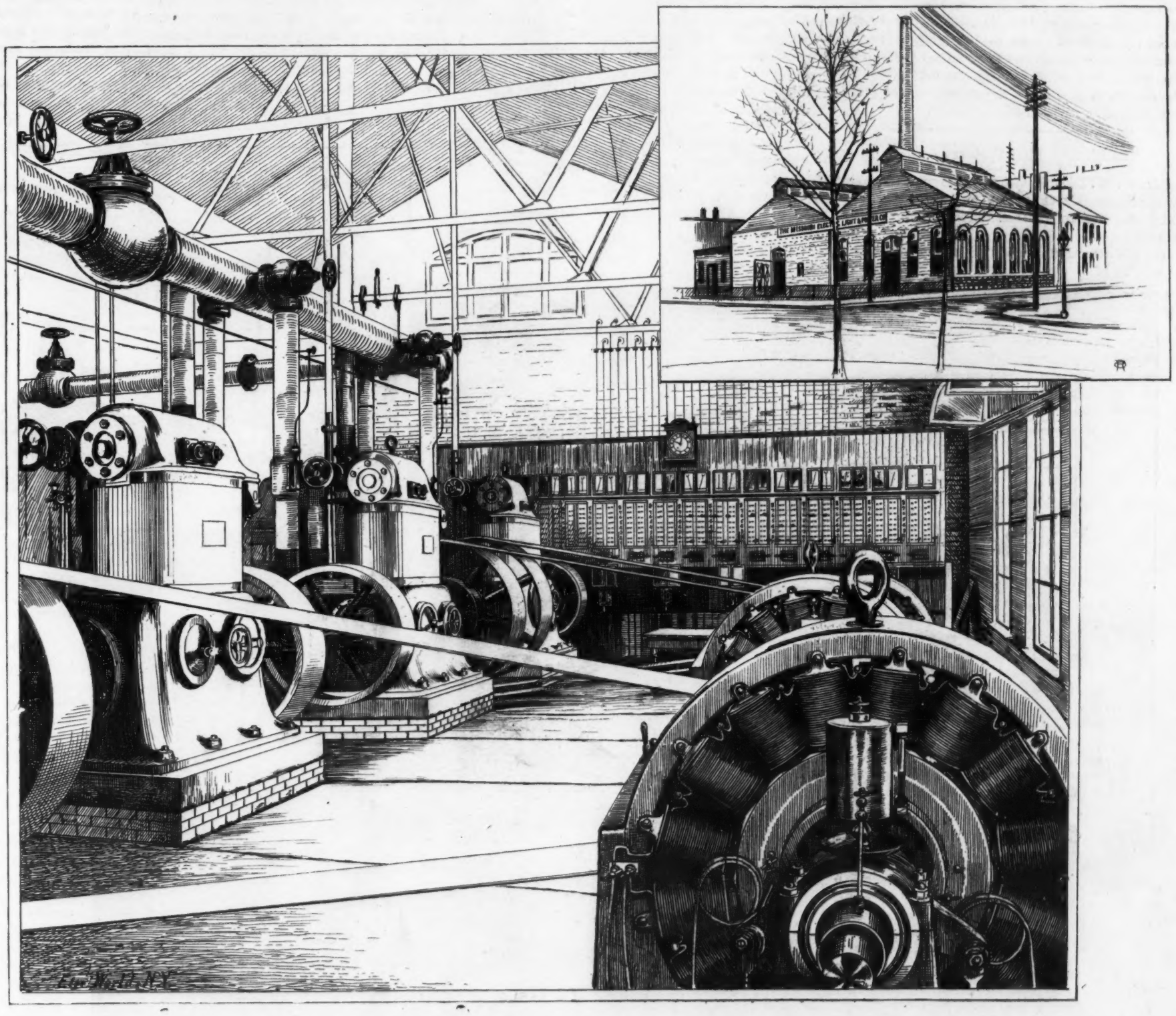


FIG. 1.—THE STATION OF THE MISSOURI ELECTRIC LIGHT AND POWER COMPANY, ST. LOUIS, MO.

the retail saloon element (which frequently constitutes a large proportion of the customers of electric light companies) being very small. It is the belief of the management that electric lighting will before long be adopted by the better classes of residences and business blocks, while it will gradually disappear from the smaller class of stores, whose only reason for using electricity heretofore has often been that, owing to the inability of the companies to meter the light, they were enabled to use far more light for less money than would have been the regular legiti mate price charged for gas. The demand for light does not seem to be in any way decreasing, being particularly strong in the residential parts of the city.

The plant was installed by Mr. Wagner, the engineer in charge, and the entire outside work was done under the supervision of Mr. E. V. Matlack, superintendent of electric lighting for the St. Louis Board of Public Improvement; and it is owing to his intelligent management that over 11,000 poles and 1,200 miles of wire have been put up within four months in the city without a single accident. Mr. S. M. Dodd is the president and Mr. S. B. Pike the general manager of the company.

The Electric Time System on the C., B. & Q.

Mr. W. W. Nichols, Chicago, the superintendent of telegraph lines on the C., B. & Q. railway system, has sent the following circular of instructions to the various offices affected.

On and after January 15, 1890, time will be sent daily to all telegraph offices on the Chicago, Burlington & Quincy Railroad in accordance with the following plan:

3:57 P. M.; the call of "time" will begin. All repeater switches should be immediately thrown so that offices may receive the call before

3:57:50 P. M., when there will be an interval until

3:58 P. M. The second beats of the master clock will now be transmitted in single dots until

3:58:40 P. M., inclusive, when another interval occurs till

3:59 P. M. Second beats are now transmitted in double dots until

3:59:40 P. M. inclusive. "S S S" will then be sent to attract the attention of those operators who have charge of the synchronizing of the standard clocks to the clock switch. This should be thrown immediately after the third "S" has been received and held until 15 seconds after the clock has been set, which will be at

4 P. M. The final signal will consist of one beat only.

This synchronized clock system was established nearly two years ago, and has given such perfect satisfaction that 150 clocks will now be connected in circuit with the master clock in the Chicago office. These various clocks will be switched into the local of a main line circuit once every 24 hours, and thus be correctly timed. The clocks are self-winding, being automatically operated by a small motor once every hour, the necessary current for both motor and electro magnets being furnished by two cells of battery placed within the clock frame.

A Farewell Dinner to Mr. O. E. Madden.

In view of his departure for Europe, a number of the friends of Mr. O. E. Madden, the new and popular president of the New York Electric Club, tendered him a dinner at the Club House on Friday evening, Feb. 7. At first the idea was to have the affair quiet and cosy, but as all who heard of it immediately desired to join in, and as there was a large contingent of Bostonians in town also anxious to participate, the "informal dinner" idea was outgrown, and a noble array of convives sat down at the board. The dinner was served upstairs, and did infinite credit to the resources of the club cuisine and cellar, as well as to those who were reponsible for the menu.

After dinner a number of excellent speeches were made, the nimble wit and inimitable chuckle of the guest of the evening putting all upon their mettle in the exchange of repartee and the provocation of fun. Mayor Hart, of Boston, spoke, as also did ex-President Gilliland, W. L. Candee, H. B. Thayer, Dr. S. S. Wheeler, W. D. Sargent, J. C. Chamberlain, J. J. Carty and W. R. Patterson. A number of interesting topics were touched upon: and Mr. Madden was surprised to learn what his friends thought of him. It is rumored that the guests were able to secure the morning papers on their way home. Mr. Madden leaves for Europe immediately.

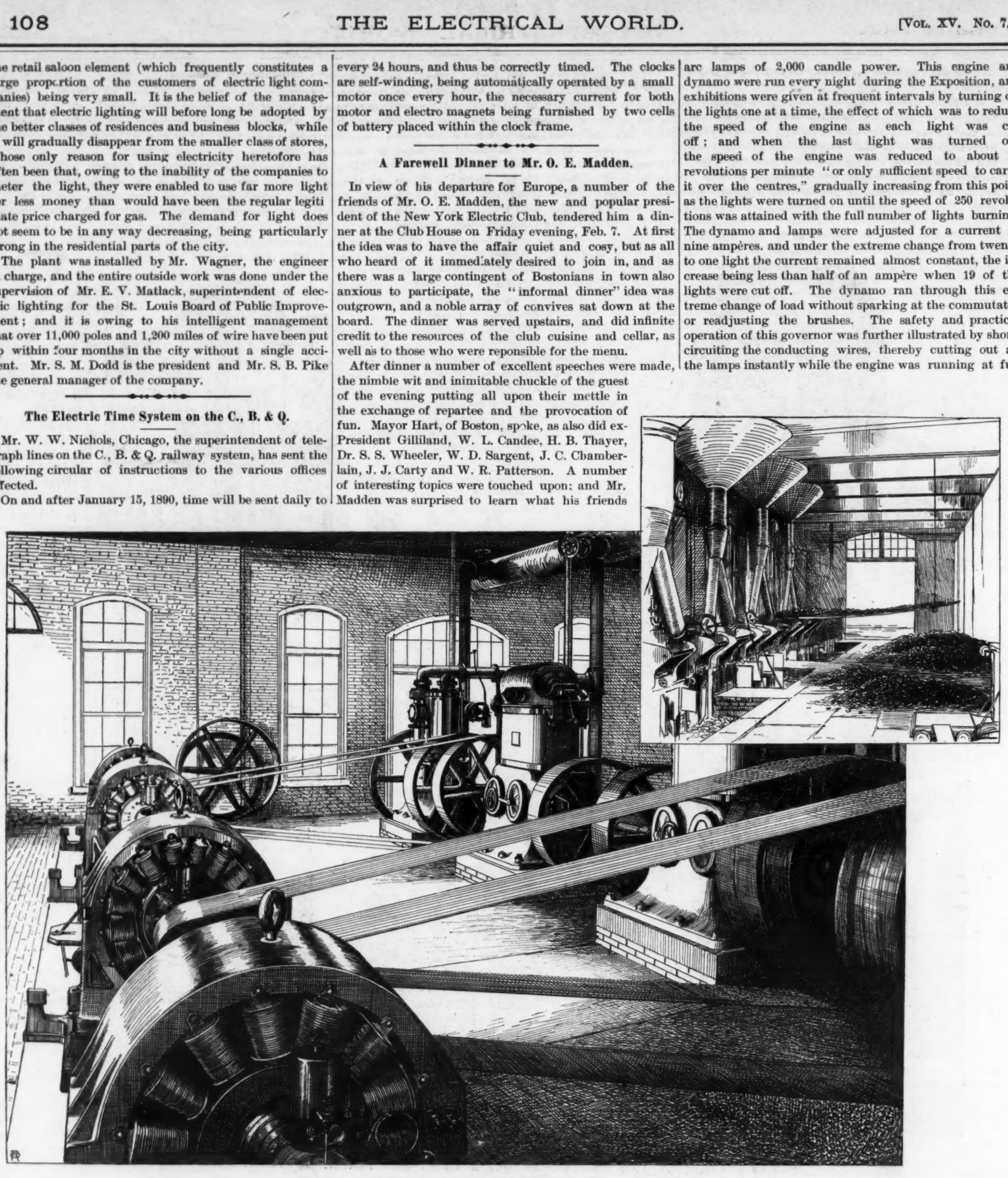


FIG. 2.—THE STATION OF THE MISSOURI ELECTRIC LIGHT AND POWER COMPANY, ST. LOUIS, MO.

Electrical Engine Governing.

To the Editors of The Electrical World:

I have read with much interest an article by Alex. Bernstein, published in your issue of Jan. 25, on the distribution of electrical energy by means of constant current, and I fully agree with the writer as to the merits and advantages as described. Mr. Bernstein says that "this method of regulation was first put into practical use by me three years ago, and has since been adopted by others." He says also: "I might remark that the falling weight has, to my knowledge, been first used by Messrs. Robey & Co. I mention this fact in order not to produce the impression that I claim priority on this point." It appears to me that Mr. Bernstein is in error in making this statement. The writer exhibited in the Chicago Exposition building, for 30 days during the exhibition in the fall of 1884, an Ide engine with an electrical governor, the engine driving a 30-light Fuller-Wood dynamo with 20 arc lamps of 2,000 candle power. This engine and dynamo were run every night during the Exposition, and exhibitions were given at frequent intervals by turning off the lights one at a time, the effect of which was to reduce the speed of the engine as each light was cut off; and when the last light was turned out the speed of the engine was reduced to about 20 revolutions per minute "or only sufficient speed to carry it over the centres," gradually increasing from this point as the lights were turned on until the speed of 250 revolutions was attained with the full number of lights burning. The dynamo and lamps were adjusted for a current of nine ampères. and under the extreme change from twenty to one light the current remained almost constant, the increase being less than half of an ampère when 19 of the lights were cut off. The dynamo ran through this extreme change of load without sparking at the commutator or readjusting the brushes. The safety and practical operation of this governor was further illustrated by short-circuiting the conducting wires, thereby cutting out all the lamps instantly while the engine was running at full speed. the effect being to reduce the speed of the engine to 20 revolutions.

The efficacy of the safeguard against the engine running away was demonstrated by opening the circuit, by drawing the wire from the binding post of the dynamo, while the engine was running at full speed with all lights on, the result being to allow the valve in the governor to drop and instantly cut off all steam, thereby stopping the engine.

This governor was patented by the writer, and was fully illustrated and described in THE ELECTRICAL WORLD about five years ago. It is of the simplest form, and a single coil magnet connected directly to the balanced valve of the governor, without pulleys, gearing, or belting, and is, therefore, simple and reliable in its operation.

The writer believes there is merit in this method of governing engines and electrical distribution, and that it will be introduced and put in practicable and successful operation in the near future.

A. L. IDE.

SPRINGFIELD, Ill.

Twenty were Killed.—Twenty people were killed in Cook County, Ill., by railway trains during the month of January, 1890. Nearly all were struck down at grade crossings. Why not bury the railways, too?

Some Applications of the New Eddy Motor.

The Eddy Electric Manufacturing Company has recently brought out a new form of motor, Fig. 1, which embodies all the best features of the ring form, so well and favorably known upon the market. The high standard of workmanship established by this Company has been maintained in every particular, and many of the details of construction are the same as in the ring form. The main difference is in the shape of the magnet. The idea and principle of the ring form has been preserved, while it has been so altered as to permit of winding it for high voltages, for which there is a growing demand. These motors are made reversible when desired, and will be adapted to any special class of work. Where it is necessary to have them mounted on a metal base, they are made in a manner just opposite to that represented in the cut, *i. e.*, upside down (see Fig. 3).

FIG. 1.—THE NEW EDDY MOTOR.

In Fig. 2 we give a cut of the new Eddy reversing motor in combination with the Holyoke hoist. This electric hoist is very light, efficient and effective. It is well adapted to mine, dock and building work. It is made with both single and double drum. It is a first-class machine in every particular, and is guaranteed to give satisfaction.

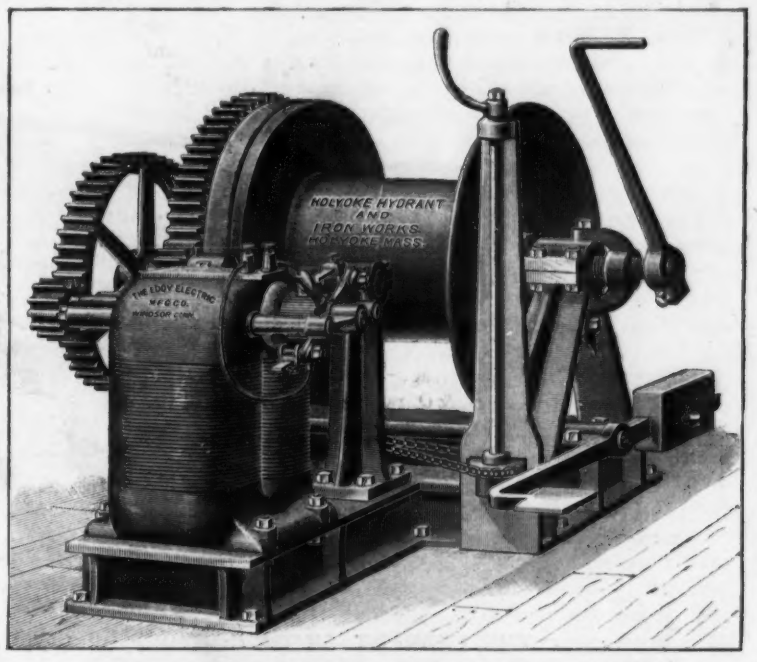


FIG. 2.—EDDY MOTOR AND HOLYOKE HOIST.

Fig. 3 represents the new Eddy slow speed reversing motor in combination with the Holyoke safety elevator for freight and passenger service. With this combination, which occupies a floor or ceiling space 2½ feet by 5 feet, the amount of friction is reduced to a minimum, no belts, pulleys or countershaft being used, and with the most satisfactory results. For passenger service a speed of 200 feet or more per minute can easily be obtained. By the use of an Eddy reversing motor, which starts or stops with the elevator, the same smooth, easy motion is secured as by the use of hydraulic power. The ratchet wheel and pawl engaging with the motor acts as a positive stop for the car should the current fail or any or all gears be broken, and acts entirely independent of the operator, thus ensuring safety.

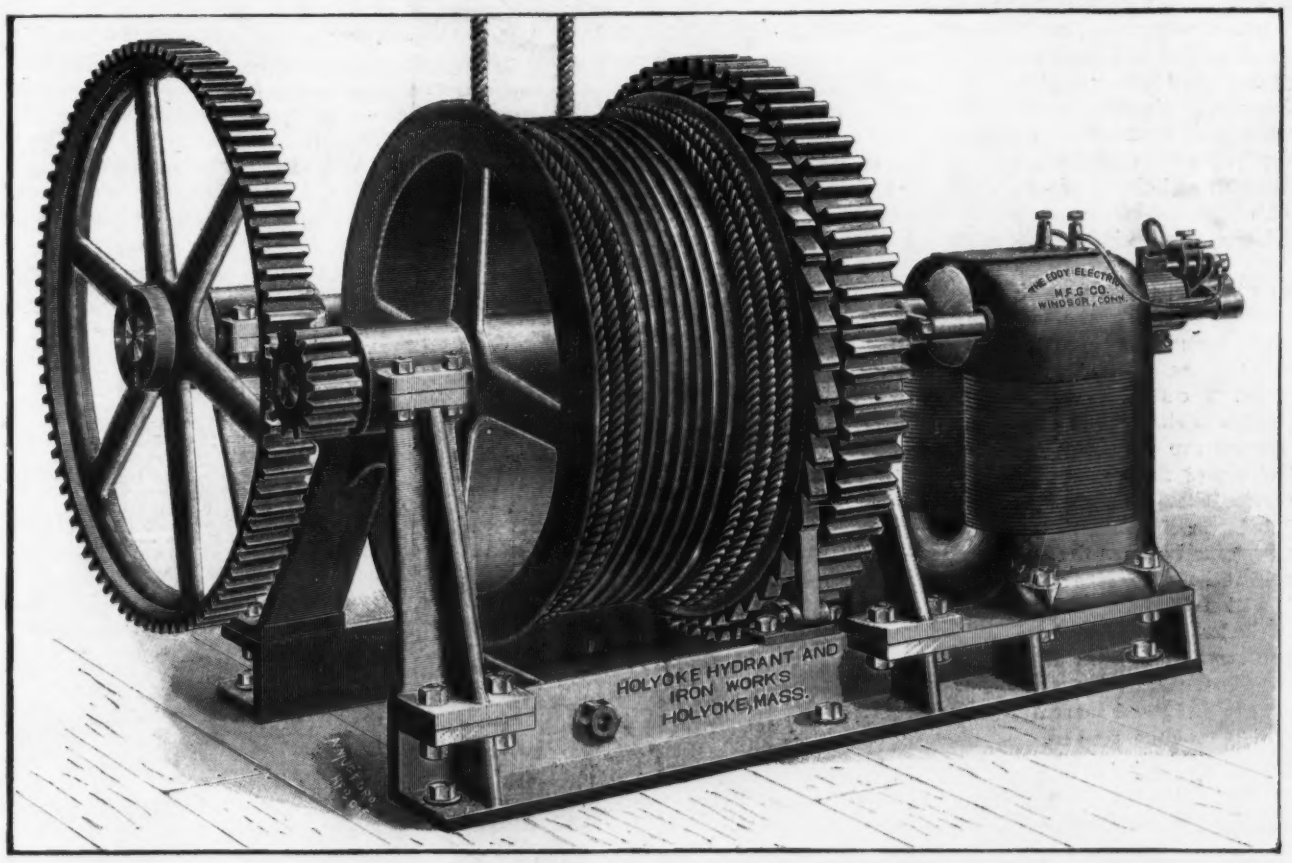


FIG. 3.—EDDY MOTOR AND HOLYOKE ELEVATOR.

Remarks upon Dry Batteries.

BY JOHN A. BARRETT.

During a recent study of the open-circuit battery problem, more particularly in that class of cells suitable for telephone service, I have incidentally made some observations upon the constitution and value of so-called "dry" forms of battery, as compared with those in which the solution is in the state of a free fluid.

I find, so far as my inspection has gone, that "dry" batteries involve nothing essentially new in the principles of voltaic action, Volta's own "pile" being a complete type of the distinguishing features of these devices. In fact "dry" batteries do not to-day present any originality in electrolytic chemistry, but merely store away the water of solution in more or less complete mechanical suspension by means of some inert absorbent material. Substantially the same chemical processes are relied upon, and, in the main, identically the same chemical materials are employed as in batteries not "dry." Also, the water of solution is always present with its peculiar and essential functions to perform, though by reason of the inactive solids with which the spaces of the battery are packed, the amount of water contained in a cell of given dimensions is very considerably diminished.

The office of water in primary batteries is two-fold; first, it is to dissolve and hold in an operative state the chemicals by which the voltaic action of the cell is excited and continued; and second, it is to dissolve and diffuse the chemical products resulting from that action. It is evident from this that the amount of water which any type of battery is capable of holding bears a direct relation to the amount of work which a fixed size of that particular battery is capable of yielding.

The relations of these propositions to the "dry" battery question will appear from an application to the case of zinc-carbon sal-ammoniac batteries. I have concluded, from a long experience with almost every conceivable form of this class of batteries, that the amount of water which any cell will contain stands almost alone and nearly independent of the size and form of the electrodes as the limiting measure of the ultimate life of the battery at any work for which it is fitted. The size and form and quality of the electrodes affect the temporary constancy of the cell, but the question whether, in any specified service for which the cell is adapted, it will continue active for one month, or six months or a year, is answered almost exclusively by the measured quantity of water which the cell is made to contain. In all these batteries it is the loss of sal-ammoniac and the accumulation of zinc oxides and ammonio-compounds which determines the final failure of battery action; and consequently the displacement of the available water of solution in any degree by absorbent solids will proportionately shorten the active life of the cell.

I do not speak of the impediment which the absorbent packing offers to the desirable diffusion and equalization of the soluble products in such cells, for, compared with the importance of the amount of water present for promoting the solubility of these products, the free circulation of the fluid is only a secondary consideration.

The value of an abundance of water in batteries will be still further emphasized by a statement of fact concerning the Leclanché battery. In this cell, so widely used in telephone and domestic work, the serviceable life of the negative element is commonly supposed to be fixed by the amount of binoxide of manganese associated with the carbon conducting plate; but it is susceptible of ready demonstration that long before the active oxygen of the manganese is exhausted, the element is declared used up and is customarily thrown out as worthless. The cause of this failure of the element is chiefly the accumulation in the porous cup and among the manganese of compounds of zinc which are insoluble in the scanty and impoverished fluid.

The result of this condition is not so much a loss of electromotive force as an increase of internal resistance of the cell. Such a clogged-up element may be made fit for a renewed term of work by judicious treatment to a washing in dilute muriatic acid, and by setting up again with a fresh charge of sal-ammoniac; or the resuscitation may be partially secured without the washing by supplying the battery with a new and strong solution of sal ammoniac, to which it is well to add a little muriatic acid.

But the clogging up of the element and the period of its activity would have been in the first instance postponed, if the element had been used in a larger jar with more water containing more sal-ammoniac. And conversely, the first life of the element would have been shortened by the employment of absorbent material, and the consequent displacement of a part of the water of solution.

A distinction should be recognized between the constancy of electromotive force under temporary test, and the duration of the period over which the cell will perform a specified amount of work. The packing of the cell with inert matter to the exclusion of a portion of the water, does not necessarily weaken its electromotive force, especially during the early stages of its service; but by so much as the water is displaced, the time is hastened when the original excitants of the battery lose their energy and are supplanted by the deleterious products of chemical action.

What is here stated of zinc-carbon sal-ammoniac batteries is equally true of all types of cells in which the impoverishment of the battery in service is attributable to the accumulation of undissolved products. Those batteries in which chromic salts are employed will evidently do more and better work with a free fluid than if the chemicals are incompletely supplied with water. In fact, the principle is of pretty general application to all open circuit batteries. On the basis of electrical measurement, therefore, it may be held that in efficiency and economy the fluid batteries are very considerably superior to the "dry."

There is furthermore one chief mechanical feature which I will mention as advantageous to the fluid batteries, and this is, the readiness with which the parts of the battery may be separated and any one part replaced by new, without the necessity of casting away or destroying other unconsumed portions of the battery. A provision for this is lacking in most "dry" batteries, and when from any cause the cell becomes unserviceable, although

the failure or defect may pertain only to a single element of the cell, the whole must be cast out and lost altogether.

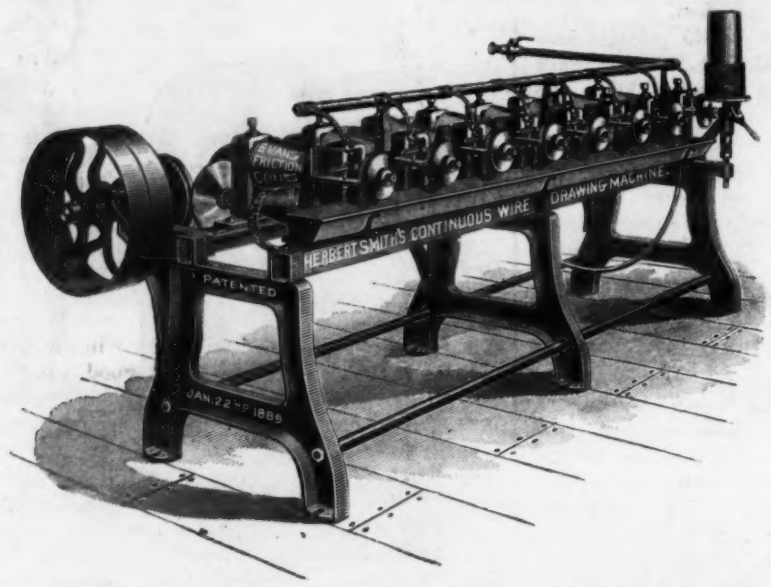
I have so far put the case strongly in favor of fluid batteries. There are evident advantages in "dry" batteries, and these advantages have led consumers to desire, and manufacturers to produce them. I have endeavored to show how the advantage has been gained at the essential loss of economy and efficiency; and this for the purpose of leading each consumer of batteries up to a consideration of where the balance lies between the gain and the loss in the selection of batteries for his particular uses, and to a more careful discrimination regarding the somewhat plausible characteristics of "dry" batteries.

With respect to "dry" batteries, there is, first, a certain kind of service for which their superior fitness is unquestioned. For portable purposes, either as testing batteries or for medical uses, on ship board or on railway cars, or, in general, in any situation where the battery is subject to movement and agitation, free fluid in the cells may be regarded as so troublesome and unsatisfactory as to leave it mainly an alternative of "dry" batteries or nothing. Beyond this, there are other uses which I can distinguish as rising superior to questions of efficiency and economy; for instance, in connection with bell ringing and domestic outfits to be sent into remote places, and to be set up and cared for by persons unskilled and liable to become confused in the details of fluid batteries, "dry" cells all ready for service, requiring only the attachment of two wires, would strongly recommend themselves. Similarly in the telephone field "dry" cells are desirable for use in the smaller country exchanges and isolated places, where the inspection and care of apparatus is necessarily left to those to whom the proper handling of fluid batteries might constitute a difficulty.

But there remains the great extent of uses in which open circuit batteries are employed, requiring the exercise of both experience and judgment in choosing between the convenience of "dry" batteries and the greater efficiency and economy of the fluid batteries. The superior simplicity and convenience of "dry" batteries for storing, handling, transporting and placing in service are acknowledged. The superior economy and efficiency of fluid cells when once applied to any specified service should, in my opinion, be also acknowledged.

And so the selection in any case between the two should be determined by the consideration of whether the gain by convenience in the manipulation of the "dry" battery is equal to, or greater than, the loss by reason of its diminished capacity for work; always holding confidently the maxim that, excepting where mechanical conditions require the contrary, every "dry" cell, when once in service, would be much improved if it could be converted into a fluid cell.

I do not regard it as too emphatic a proposition to say, in conclusion, that so long as "dry" batteries are essentially nothing but modifications of fluid batteries with an insufficient supply of water, experience will demonstrate that the field of their usefulness is rather narrow and specialized.



THE HERBERT SMITH CONTINUOUS WIRE DRAWING MACHINE.

The Herbert Smith Continuous Wire-Drawing Machine.

The subject of copper wire and its production must always be a source of great interest to electricians, as it enters into the construction of every conceivable piece of electrical mechanism. In wire factories the usual method is to draw wire down by means of repeated operations, in separate machines, but we illustrate this week a machine which has been recently devised and introduced by Mr. Herbert Smith, of Worcester, Mass., which enables the wire drawer to produce the finest qualities of wire in one continuous operation. Machines of this class, although tried previously, have never had a very successful career, owing to the complications arising from the necessary gearing but Mr. Smith, realizing the great possibilities of the Evans frictional system of transmitting power at any desired speed for the various drawing pulleys, has, by the adoption of that system, succeeded in devising a machine which is being adopted by the larger wire concerns throughout the country.

The main shaft of the machine, by the use of the Evans frictional system, is driven at a uniform speed by means of ordinary belting from a factory line shaft, and the driving pulleys can be each arranged to run at separate and distinct speeds, conforming to the speed at which the wire has to be drawn through. It is, of course, understood by any one familiar with wire drawing, that to enable the wire to be drawn by a continuous operation, the speed in the final pulley, when the wire is reduced to its final size, must necessarily run at a very much increased speed over the pulley which performs the first drawing down process. As will be seen in the engraving, the bottom cone revolves at a uniform speed, and by shifting the small leather belt further up or down its surface, the top cone, which is geared to the drawing pulley, can be made to revolve at any desired speed. If the belt is at the small end of the uniformly revolving cone, the upper cone will revolve very slowly, while if it be moved by means of its controller to the large end of the same cone, the upper cone will revolve very swiftly. By setting the belts at certain defined positions, the upper cones are made to revolve at various speeds, and the object of the machine is attained.

The machine is designed for the rapid and perfect reduction of wire by a series of dies and draft pulleys, and for giving any desired number of simultaneous and continuous reductions. The mechanism comprises cone pulleys for the accurate adjustment of the speed of the several draft pulleys, so that they will take the wire at a rate proportional to the reduction at the several dies. Means are also provided whereby the die holders can be universally adjusted and the wire-drawing dies made to stand exactly square with the draft pulley.

The die holder and draft pulleys are so made that if it is found desirable to change the diameter of the finishing block this can readily be done, only delaying the machine a few moments.

The machine is, in addition, provided with appliances for a constant supply of lubricant to the several dies, and with minor improvements which go to make up a complete and efficient machine for drawing copper, brass, iron or steel wire.

The Evans Friction Cone for Driving Dynamos.

One of the exhibits that attracted a great deal of attention at the Maritime Fair, lately held in Boston, was that of the Evans Friction Cone Company, of Boston, Mass. The dynamo which furnished the current for the 10,000 c. p. search light of the Thomson-Houston Electric Company designed for ship use, which was so noticeable for miles around the city, was driven from a Westinghouse engine by means of this system.

This is not, as many suppose, an ordinary simple friction, but differs very materially both in principle and results from other methods formerly used. The power is transmitted from one pulley to another by a series of loose belts, which encircle one and run between them both. Owing to the use of this loose belt there is brought about a peculiar action, and it is to this feature that the efficiency is said to be due.

In common friction the driving and resisting forces are both applied at the line of contact of the two pulleys. In the case under consideration the belt cannot be considered a part of the pulley on which it is placed; and while the driving forces are applied as before, the resisting forces are applied on the inside of the belt, and the two forces constitute a couple of which the thickness of the belt is the moment arm. Since the belt is loose and free to move under the action of these forces, the rotative effect of the couple will incline that part of the belt which is passing between the pulleys in such a manner that it will be thrown up against the driving pulley and down against the driven, so that the pressure will be transmitted in an oblique direction. With this explanation it can be understood why there is no slip when a load is suddenly applied, for the application of the load is accompanied by a corresponding increase in the driving and resisting forces, and this increase will cause the belt to trip with more power and hence diminish the liability to slip.

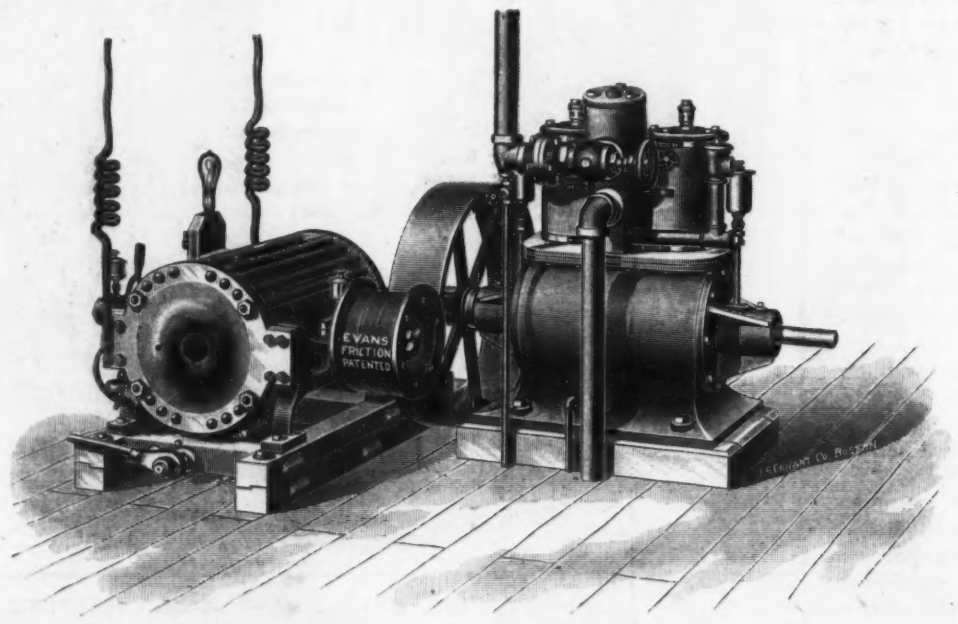
This action is entirely automatic, and a load may be applied to the full capacity of a belt and easily carried without slip, although when at rest the pulleys and belts touch so lightly that they can be easily slipped by each other with the hand. It has been demonstrated that more power can be transmitted in this way with no more pressure on the bearings than by the use of ordinary belting.

The accompanying engraving was made from a photograph of the Evans Friction Cone Company's exhibit, and shows at a glance one of the many advantages that this system possesses, namely, the small space occupied. In this instance the test was severe, for since there was but one large light, the full load was necessarily thrown on at once. Moreover, when the carbons in the lamp touched, as was frequently the case, it being regulated by hand, the dynamo was practically short circuited through the carbons, and the load greatly increased, and although this caused a furious sparking at the commutator, no slip could be detected.

Besides the saving of room there is also a great saving of belting. Clutch pulleys and belt-holders are dispensed with, for each dynamo in a station may be started or stopped by creating, or relieving, the pressure on the belt by moving the dynamo on its base in the ordinary manner

The system is equally well adapted to small and large plants. One or more dynamos may be driven from the fly-wheel of an engine, or they may be arranged on both sides of a long shaft, carrying the driving pulleys. For marine installations, it has been found that less space is required for a plant of a given capacity than would be occupied were the system of direct coupling employed.

Although this system has been in use but a comparatively short time, yet there is some 2,000 h. p. running and in the course of constructon. The city of Boston has this system in its Chestnut Hill pumping station, and it is also in use by several electric light and power stations and factories.



THE EVANS FRICTION CONE FOR DRIVING DYNAMOS.

The New Stephenson Vestibule Electric Street Car.

Next to the improvement in the motor and electrical equipment generally, electric street cars have undergone rapid changes, and the process of improvement is by no means at an end. Among the recent advances in this direction we note the improvements introduced in the new

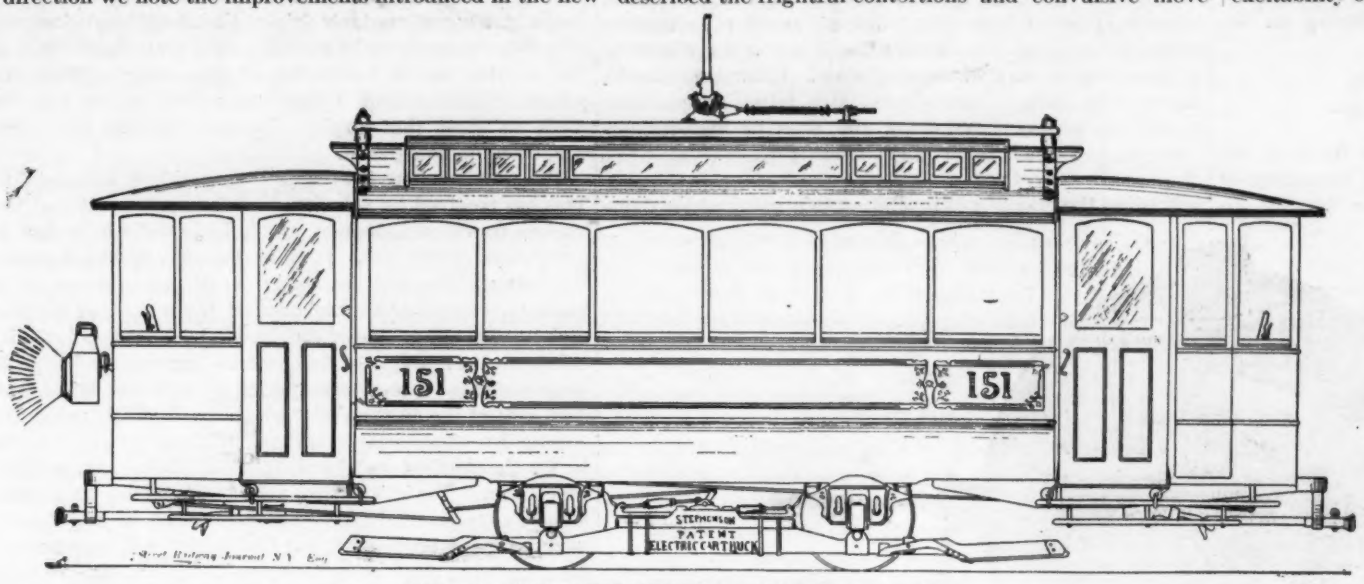
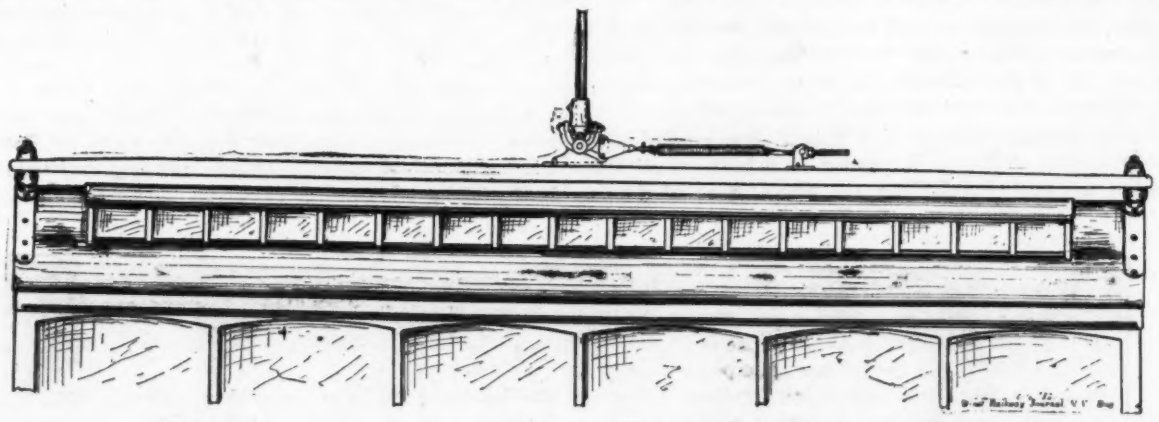
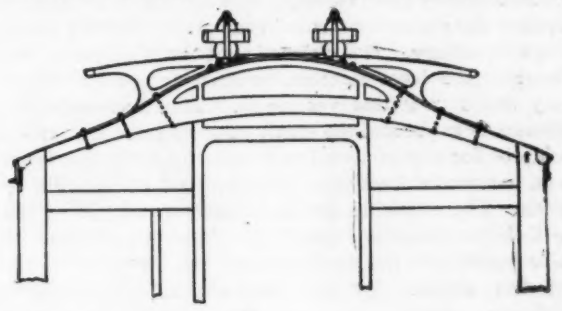


FIG. 3.—THE STEPHENSON VESTIBULE CAR.

vestibule street car now being built by the John Stephenson Company, Ltd., of this city.

In the majority of cases heretofore, it has been customary to fix the base of the trolley arm directly on top of the roof of the car, and then, in order to strengthen the roof to meet this additional stress, stronger roof curves have been put in to support the roof. All this has tended to make the roof look heavy and unsightly. To avoid this, the new Stephenson car has been designed so that the trolley stand





FIGS. 1 AND 2.—LONGITUDINAL AND END VIEW OF CAR ROOF.

rests upon two boards which are bolted between rubber cushions, mounted on two strong iron bands at either end, to the car roof timbers. This construction is illustrated in the accompanying engravings, Figs. 1 and 2, which show respectively a longitudinal and an end view of the roof of the car. The construction is made specially strong, and as the trolley stand and arm are free from contact with the roof of the car, all racking and consequent damage to the roof is avoided. Besides, the mounting of the boards between rubber cushions insulates the trolley arm from the body of the car, which is an additional advantage. The roof of the car is of the latest improved Bombay top, with illuminated lettering at the sides.

The body of the car is of the usual 16 feet, and the windows are of extreme height, with metal sashes and rubber cushions. As will be seen in Fig. 3, the platforms are extended and inclosed in such a manner as to form abundant room for the entrance and exit of passengers, while at the same time isolating the motorman as much as possible from the passengers, and protecting him from the weather. The ends of the car are also provided with automatic drawbars, so as to permit of the coupling of cars for the formation of trains if necessary.

The improved truck, which is shown in perspective in Fig. 4, carries the motor machinery and brake gear, leaving the body of the car free to rest on rubber cushions, and thus avoids all jar and shock incident to the operation of the motors. As will be seen, the truck is separated from the journal box by an improved hinge joint, and the simple removal of three bolts enables each pair of wheels to be taken from under the car quickly and easily. The nose-piece or guard for the motors is attached to the truck between rubber cushions held in position by iron goosenecks fastened to the centre of the frame. The latter is diagonal in construction, by which great rigidity is secured, together with easy riding. We may add that the Stephenson Company is building one of these cars for the Georgetown, D. C., Street Railroad; and a large number of their cars, as our readers are aware, are in operation on electric railroads in this country, while a number are now in course of construction which will be shipped to Europe upon completion.

On Muscular Movements After Death by the Electric Current.

BY PROF. EDWIN J. HOUSTON.

In several of the recent cases of death by the electric current, in New York and elsewhere, witnesses have described the frightful contortions and convulsive movements exhibited by the body of the person receiving the discharge. That such movements actually occurred in those cases, in which the current continued to pass through the body, there appears to be no room for doubt. Nor can there be much doubt that, where they have not occurred, the contacts with the body must have been but momentary. There is, however, very considerable room for doubt that such movements were indicative of any actual suffering on the part of the individual receiving the discharge; or that, in point of fact, they preceded actual death for any very appreciable time.

Though accurate data are wanting as to the precise interval required to cause the death of a human subject from accidental contact with the electric conductors conveying high potential currents, or by the discharge of a lightning flash, it would appear that true physiological death, as evidenced by the entire cessation of the normal functions of the respiratory, cardiac, and brain centres, and the impossibility of again restoring their normal actions, is practically instantaneous, when the contacts are such as necessitate the passage of the current through the principal vital organs or nerve centres.

In cases of lightning discharges, it appears beyond reasonable doubt that death is practically instantaneous. In some instances the persons killed have remained in the exact position they had during life, so that passers-by failed to detect the fact of their death. Then, too, in nearly all cases, where the discharge produced only temporary unconsciousness, the person, on recovery, has been unable to remember any pain or sensation following the discharge.

The actual presence of convulsive movements on the part of the subject does not at all demonstrate the presence of feeling or even of life. In all probability, physiological death has occurred very shortly after such movements have been started. Galvani's classic experiments with the frog's legs have demonstrated the fact that the electric excitability of nervous and muscular fibre exists long after death. Even in the case of portions of the body, such as the legs, etc., completely separated from the rest of the body, the same susceptibility to electrical excitation exists, nor is this excitability absent in cases of undoubted death of the human subject, as numerous experiments with recently executed criminals unquestionably demonstrate.

In the case of the recently excised frog's legs, muscular contractions resulting from the passage of the current, occur only on making or breaking the circuit. When the current is fully established and is flowing steadily through the nerves, muscular contractions are practically absent. This, however, is true in general of frog's legs only. Du Bois-Reymond has pointed out the fact that in the human subject it does not hold good, except for very weak currents. As soon as the currents exceed a certain strength they stimulate the nerves and cause contractions, even when their flow is steady and continuous; and, as is well known, the passage of any continuous current effects that profound modification in the state of a nerve, known as the electrotonic state. When a very powerful current traverses a nerve, persistent tetanus soon sets in and muscular contractions cease. If the current strength is such that a pathological change occurs either through electrolysis or otherwise, the nerve may lose its ability to be subsequently stimulated by the current, after a period of rest; otherwise, it may, after sufficient rest, regain this power.

In the case of the powerful currents employed in electric lighting and power distribution, the fact that the tetanus probably occurs after a short interval may, at first sight, appear to militate against the belief that muscular contractions actually occur after physiological death. A brief consideration of the conditions under which the current passes through the human body will, however, completely remove this objection.

When two electrodes of comparatively limited dimensions are applied to the different points of the human body, a current passes through the body from the positive to the negative electrode. The force of this current, however, is not limited to those portions of the body which lie directly between the electrodes. A diffusion of the current occurs throughout the entire body, whatever may be the points of application of the electrodes. The current density, however, or the strength of current per unit of area of cross section of any part of the body through which the current is passing, will be much greater in those parts which offer the least resistance to its passage; that is, in general, in those parts which lie in the path of least distance between the two electrodes.

While, therefore, in cases of death of the human subject by the passage of the current, although the nerves and muscles lying in the direct path of the discharge in all probability almost immediately lose their power of being stimulated by the current, either a result of tetanus, of

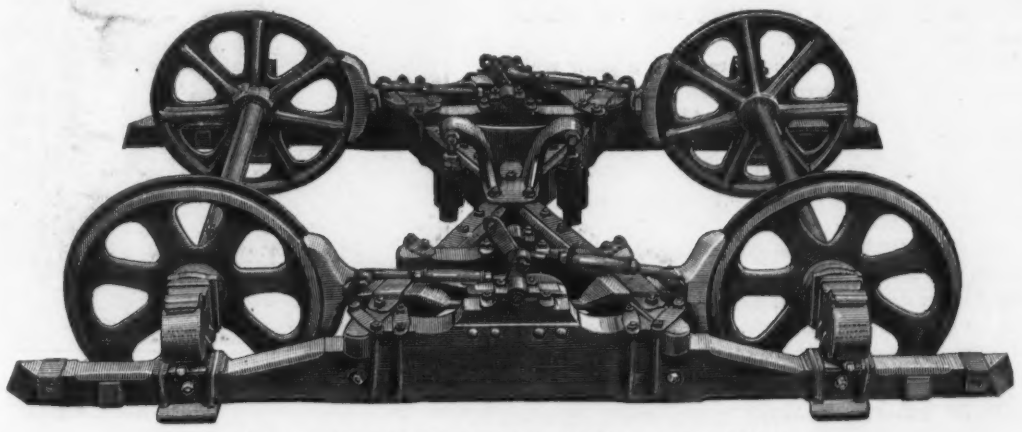


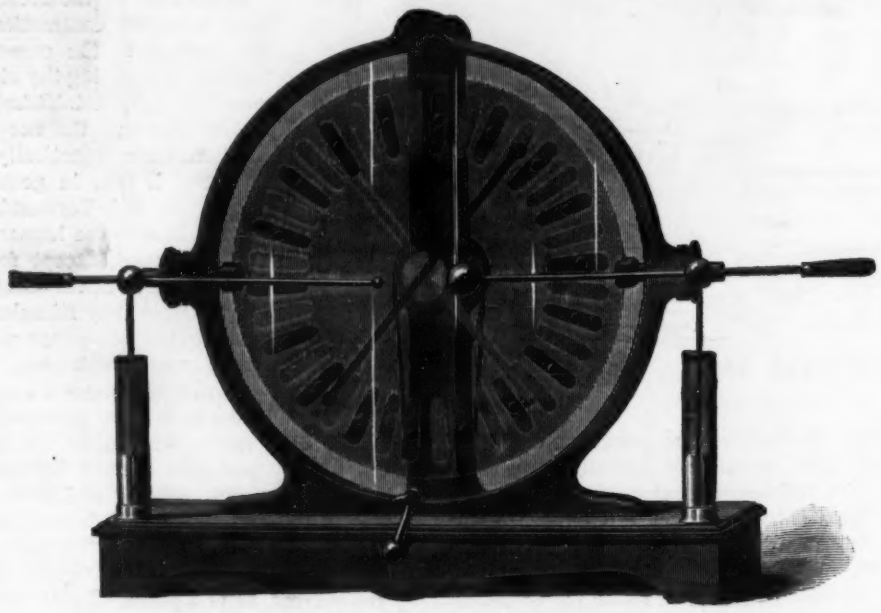
FIG. 4.—IMPROVED STEPHENSON CAR TRUCK.

pathological changes, yet those nerves and muscles lying along, or in the paths of, greater resistance, and consequently of smaller current, might continue to produce convulsive contractions on the passage of the current long after true physiological death of the respiratory, cardiac, and brain centres had ensued.

The actual presence of muscular contraction, therefore, on the part of a person receiving a fatal electric discharge does not necessarily prove a continued suffering on the part of the subject.

An Improved Wimshurst Machine.

We illustrate on this page an improved form of the Wimshurst influence machine. It consists primarily of two revolving glass discs near together, and having an equal number of tinfoil sectors. These discs revolve in opposite directions by means of belts and pulleys controlled by a hand crank. The glass discs are inclosed between two stationary glass plates, firmly set in the frame, protecting the generators from injury, dust, and the condensing of moisture. It is claimed that the Wimshurst instrument is the least affected by changes in air moisture of any static machine yet made. The accumulation of charge is rapid and the spark large and strong. It is well adapted for experimental purposes, multiple gas lighting, and in a medical way for the treatment of nervous affections. The machine is handsomely mounted in cherry with brass trimmings, and is the simplest and most effective machine of the kind we have yet seen. It is placed on the market by the Electrical Supply Company, of Chicago.



IMPROVED WIMSHURST INFLUENCE MACHINE.

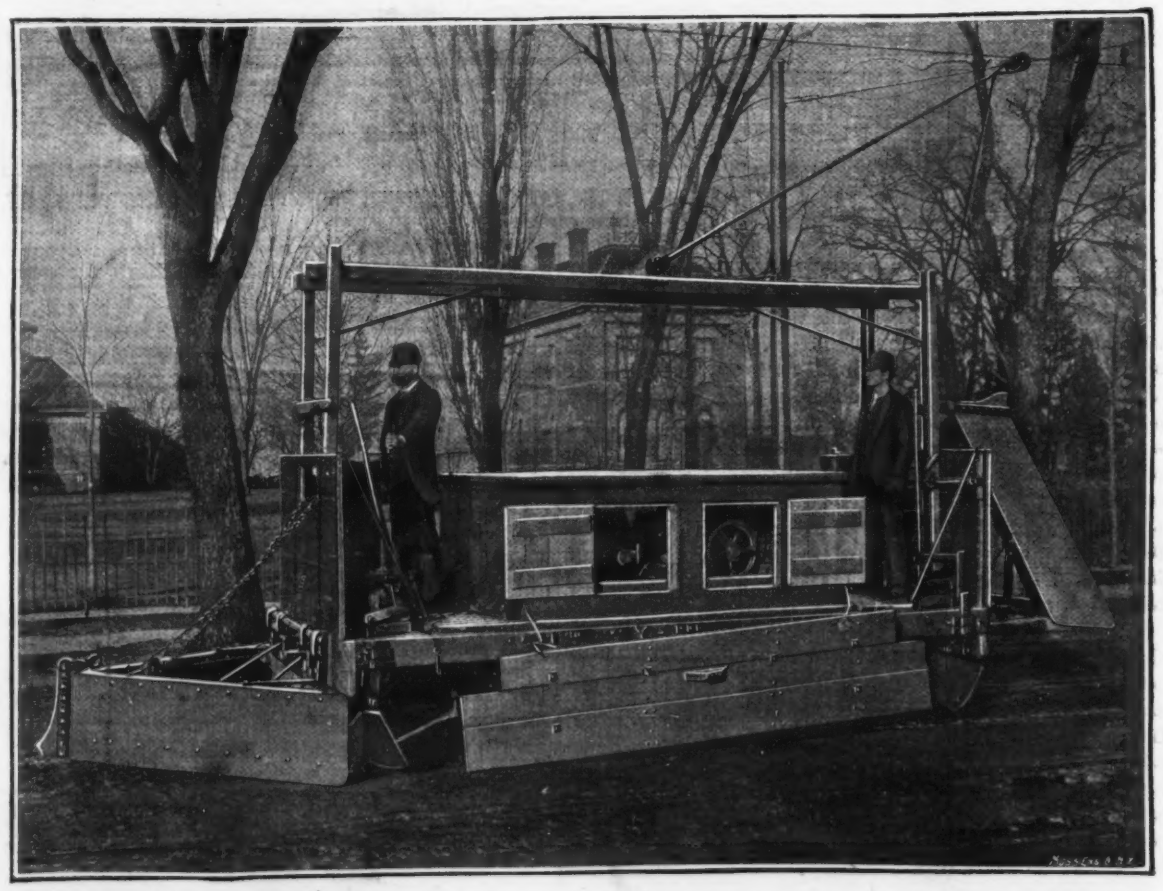
Sprague Electric Snow Plow.

We illustrate in this issue a new electric snow plow, which has just been manufactured by the Sprague Electric Railway and Motor Company. This plow is fitted with two 15 h. p. improved Sprague motors, and is so arranged that it can be run either forward or backward like an ordinary electric car.

The reduction in gearing between the motors and the car axles is greater than in the ordinary Sprague car, so that a large amount of power is available from the motors in case of necessity. It is estimated that this plow will clear the track more speedily and effectually than an ordinary snow plow drawn by 12 horses.

The view shown is from a photograph of a plow which has been in operation for some time on the Troy & Lansingburg Street Railway, Troy, N. Y. Although the season has not offered much chance to show the large capabilities of this plow on that road, the plow has effectually taken care of several light falls of snow which have obstructed the tracks this winter.

We understand that the Sprague Electric Railway and Motor Company have nearly completed a special sweeper and track cleaner for clearing the track of dust, dirt, slight snowfalls, and other impediments. This sweeper will he operated by the Sprague improved motors.



THE NEW SPRAGUE ELECTRIC SNOW PLOW.

Operation of Electric Motors with High Tension Currents.*

BY ELMER A. SPERRY.

The recent advance in the transmission of power by electricity in this country and abroad, and its adoption on a more or less extensive scale for the utilization of distant water powers in the mining districts, indicate that the state of the art has reached that point where it has ceased to be an experiment, and where the most direct methods and the betterment of the various details of construction are matters of paramount importance. The present widespread interest in high tension currents and the discussion in connection with their use in the distribution of electricity for electric lighting, lead me to the few remarks which follow, hoping to attract attention to their employment in the transmission of power, that this field for the use of high-tension currents may not be neglected, and may also receive whatever benefit may result from the general discussion now in progress.

For the transmission of power from one point to another there can be no question as to the utility and great advantage of employing high potentials. I speak now of the transfer of power from one point to another as contra-distinguished from the distribution of power for domestic or like purposes on a widespread scale. I, however, see no reason why, in the near future, this latter system also should not be prosecuted along the lines of high-tension currents, inasmuch as the phenomenal progress which has characterized electrical engineering enterprises in the past will bring the question of insulation to a point where damage to life and property will almost entirely cease to be an element to be considered. This will doubtless be brought about, too, by the utilization of safety devices in the central plant, as well as throughout the construction.

In the consideration of high potentials as applied to the transmission of power, I propose to take a practical instance and carry it out along the line of each of the two foremost plans known to electrical engineers, namely, first by constant current, and second by constant potential, hoping by this means to point out the principal differences and ascertain, if possible, which is the better, cheaper and more desirable method.

Before starting with the examples, it is desirable to settle the fact that the work of each of the plants shall be satisfactory in so far as practical operation is concerned. This will depend upon economy and regulation. We will assume, so far as the practical operation is concerned, that with shunt, compounded or over-compounded generators, and with shunt and compound wound motors, the matter of regulation may be satisfactorily worked out. But can the regulation be equally well maintained upon the constant current plan?

It will be granted by all who have investigated the matter that constant current generators can be regulated automatically, as to their potential, from zero to full load, in response to demands thereon for work, and this is done in a satisfactory manner. But referring to the motor, the argument used against the constant current method is that the field coils have to be divided each into a great many parts, each of these parts led to sections of a stationary commutator, and contacts driven backward and forward over this commutator by means of the centrifugal force of the varying speed tendencies of the motor. That the potential difference of a constant-current motor may be made to meet the varying demands thereon for work has been demonstrated.

The problem here is to obtain a sparkless commutator. This has received its solution and the mathematics of the various functions is known, and holds equally in motors or generators of any size. Furthermore, the sparkless region for varying currents has been broadened out until it is made to comprehend a variation of 50 per cent. of the normal current either side of the normal current point. By this is meant: Suppose the normal current to be at 40 ampères, then there is a region of 20 ampères lying half each side of the 40 ampère mark through which range the commutator is entirely sparkless. This seems to me to be by far the simplest way by which to adjust a constant current motor. Various devices may be employed to accomplish the mechanical rotation of the brushes in response to varying speed tendencies, but that which will recommend itself as being the best is the one in which the varying centrifugal forces are called upon to do the least amount of mechanical work. These forces are not great until the speed differences are great, hence for close regulation they should be called upon to perform only functions involving light duty, for instance, calling into action mechanical forces which in and of themselves perform the ultimate duty of rocking the brushes, especially in heavy machinery where these elements are more or less large and ponderous.

The question may be asked: Can centrifugal force ever be employed to hold the motor within the same speed limits as shunt or compound winding? I answer, it can. There is no reason why the same degree of perfection should not be attained in this as in steam engineering. There are steam engine builders who will contract to hold the speed within 1½ per cent. from full load to zero. No better result than this need be desired in any motor.

Electrical science has advanced so rapidly and the theories have changed so radically that statements put forward but comparatively a few years ago naming impossibilities in the art have been often exhumed in the present day as marks of advancement. Writers on dynamo machinery are so modern that, profiting by the errors made by former writers upon other subjects, they have been rather wary in pointing out impossibilities. But sweeping assertions must be made, and writers who are considered as high authorities have pointed out the impossibility of making a sparkless commutator under the conditions named above. Since it now has become an accomplished fact, it may be said that doubtless these statements denying the possibility of results of great importance are useful as incentives to those working along the line, who do not agree with the author.

There is, however, one point with regard to a sparkless commutator, under conditions of constant current, which I wish to point out, namely: That from the maximum to the

* Abstract of paper read before Chicago Electric Club.

minimum point of potential the brush must always be handled in the direction it points from the former point toward the latter, and not in the opposite direction. The distribution of potentials about a commutator is equal on either side of the maximum line, and there seems on the face no reason why the brushes should not reduce the potential if rotated in either direction from the maximum point, either toward the left or toward the right. While the brushes in their movement to the left are perfectly non-sparking, if attempt is made to move them in the opposite direction they spark seriously.

To proceed with the example. Let us take a transmission of 50 h. p. three miles distant upon a circuit of 31,680 feet. Place the total economy of transmission at the low figure of 66 per cent., with the losses distributed 14 per cent. each in dynamo and motor, and 5 per cent. in the line. We will adopt as potential 3,000 volts; transmissions are used 24 hours a day with this voltage, as well as scores of arc light dynamos, with no practical inconvenience. This voltage would give about 18.7 ampères on the constant current distribution. Let us assume that a constant potential may be worked upon the same voltage. Now let us examine the two plants. The line wires are the same size, with this difference, however, that in the constant current they are only subjected to 3,000 volts at such times as the plant is working at its maximum; during all other times the voltage is lower, thus subjecting the insulation to a far less strain, with less liability of breaking it down; whereas in the constant potential system this 3,000 volts is maintained constantly, whether there is any power being used for the motor or not, even if the motor is driving itself solely. The heavy stress upon the insulation, therefore, is constant. The armatures are practically the same, because for the same speed and same field intensities the number of convolutions and sizes of wire will be equal,

Let us examine the fields. Taking 3 per cent. of the total energy required in the fields, we have in the field of the constant current machines merely a series wire measuring 10,000 feet, with a difference of potential at its ends of 100 volts, running 100 feet to the volt, being a large wire easily handled and one that will withstand shocks, jars and rough handling indefinitely. Taking the same number of square mils per ampère for the wire in the field of the constant potential machines, we find that an extremely small wire has to be employed. We find that this wire must be 62 miles in length; we find that the difference of potential between each successive layer upon the fields is 200 times that which exists in the constant current fields, taking at least forty times as long to wind the same. This great increase of potential difference between the successive layers should require double-covered wire. Let us see what bearing this has upon the case. With double-covered wire of this size the ratio of insulation to copper would be 44 per cent., whereas in the constant current the ratio of insulation to copper is only about 3 per cent. This requires about 40 per cent. more field space in the case of the constant potential, which means a larger machine as compared with the constant current generator. The actual net cost, pound for pound, of wires, in this instance, would be three and one-half times as great in the constant potential as in the constant current machine, making the total cost of insulating wire for the field of the constant potential machine over four times that of the constant current.

These details indicate plainly impracticability on the part of the constant potential and perfect practicability in the case of the constant current. This impracticability is not decreased as the complexity of the machine is increased by being compounded or over-compounded. In fact, an eminent writer on constant potential machinery, no later than November last, in discussing a pressure of only 1,000 volts, states, "that where high-pressure generators are used, it is very expensive to wind a shunt field of high enough resistance to stand the electromotive forces of the armature. It is much cheaper to wind a shunt field for low pressure, say of 110 volts, and separately excite it by a small constant potential dynamo." This, of course, would add to the plant another item of expense which would be slightly more expensive, though far more practicable, than the field winding described above on the 3,000 volt basis.

In the practical operation of constant potential motors, the use of an artificial resistance is imperative, by means of which the lack of counter-electromotive force in the armature of the motor, as the speed starts and increases to the normal, is made up by dead resistance. This resistance for large motors occupies much space, and in case of high potentials is expensive. In the constant current plant, however, a switch shunting the motor is opened and there is at once thrown upon the motor only its normal amount of current, and as the same starts and its counter-electromotive force increases, the electromotive force of the generator also increases in proportion, until its normal speed is reached, without at any time any increase of current whatsoever or tendency to burn. On the other hand, with the constant potential, should an accident happen and the machinery be brought to a stand suddenly, there is serious danger of overheating and burning the coils of the armature and series coils of the fields. In this emergency the constant current is cared for automatically by the regulator on the generator which diminishes the potential upon the line, correcting the current intensities almost instantaneously. Upon both constant potential motor and generator as the load increases and diminishes, a manual adjustment is also required to keep the brushes on the non-sparking point.

It is found in practice that if constant potential motors, as ordinarily constructed and connected in circuit, are belted to the same shaft or otherwise connected to the same work so that they must revolve together, the result obtained is unsatisfactory because of the fact that the load will be unequal and disproportionally divided. This is due to the fact that it is impossible to construct two electric motors, the armatures of which shall have precisely the same counter-electromotive forces; therefore, if two motors coupled together in this way are supplied from the same main the armature which produces the lowest counter-electromotive force will take a larger current than the other motor. The effect of this increased flow is to greatly exaggerate and enhance the difference existing between the motors, because the fields of the motors are disturbed by the increased flow and its counter-electromotive force is still further reduced, resulting ultimately in burning or destroying one of the motors.

Prof. Rice has recently devised a system to overcome this effect, but at best it is complicated, and still further increases the complexity of the machine. Another way would be to run each motor connected to a separate generator with separate line wires, but this, to say the least, is expensive. Any number of constant current motors may be attached to the same power; in this case their regulators are dissimultaneously operating. Having thus pointed out some of the differences, let us look into the stations provided with these two sets of apparatus. In the constant potential generating station we find a very large machine. Upon the wall are an ammeter, a voltmeter, a large rheostat for controlling the fields, and most probably an exciter and duplicate set of station instruments. Connected with the exciter, at the motor end of this line, we find the motor, a large rheostat and probably another exciter. Going over now to the generating station of the constant current machine, we find an automatic generator which is smaller than the constant potential machine. On the wall we find simply an ammeter. At the motor station we find a motor supplied with a small and durable mechanical regulator for its fields, or preferably for its brushes, and perhaps an ammeter upon the wall. This constitutes the entire plant. Nothing about it but what can be easily comprehended and successfully operated by an engineer of ordinary intelligence, and we observe an entire absence of complexity of connections in the machines, or circuits running back and forth from the machine to the various devices upon the switchboard or wall; and the first cost and cost of installation of these various devices is decidedly in favor of the constant current system.

It may be said that some of the objections above will be eliminated by reducing the E. M. F. of the constant potential plant. Let us reduce it one-half, that is, to 1,500 volts. Now, it is true that the fields are less difficult to wind, the length of the wire is less and the wire somewhat larger, enough so, perhaps, to do away with the necessity of an exciter. An increase, however, will have to be made in the size of wire on the exterior circuit. The current is now increased to 37½ ampères, and for the same loss in the exterior circuit the wire will have to weigh 14,000 pounds instead of 4,000, costing $2,800 in place of $800; and if the potential is still further reduced to 1,000 volts, in which case there would be 56¼ ampères, the wire would weigh 18 tons and cost $7,200, as compared with $800, for the constant current plant, with poles in the former at much less intervals and heavier construction all through.

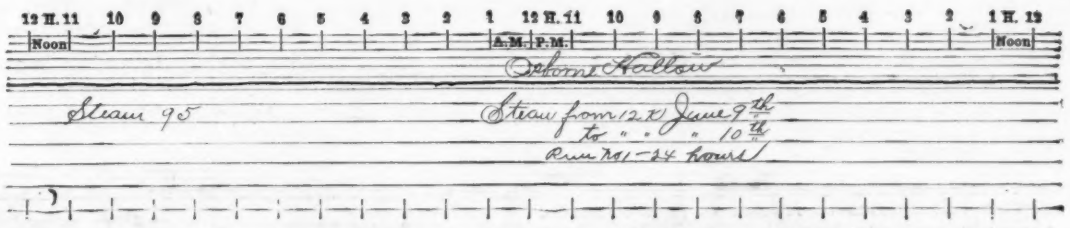

12 M. 11 10 9 8 7 6 5 4 3 2 1 12 M. 11 10 9 8 7 6 5 4 3 2 1 M. 12
Noon
A.M. P.M.
Noon
Osborne Hollow
Steam 95
Steam from 12 M. June 9th
to " " " 10th
Run 24 hours

FIG. 2.—RECORD OF HOFFMAN DAMPER REGULATOR.

The Hoffman Damper Regulator.

Economy in the consumption of fuel requires a strict watch to be kept on the fires, and as even the best of firemen are apt to be lax at times, automatic devices for regulating the fires have recently come into vogue. Among these the damper regulator has taken a prominent place; and a recent addition to this type of fuel-saving devices, is the Hoffman damper regulator, shown in the accompanying engraving.

The regulator as shown consists of a cylinder with a solid piston, carefully fitted and loaded with weights to render it sensitive and prompt in action. Below the cylinder is a valve chamber, projecting at right angles, which contains the regulating valve, that is controlled by a lever and ball. At the short end of the lever is attached one end

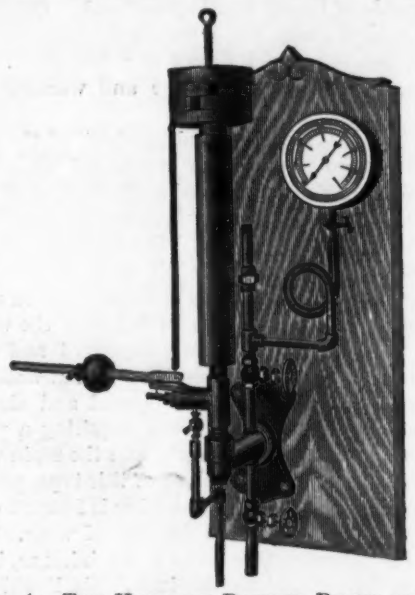


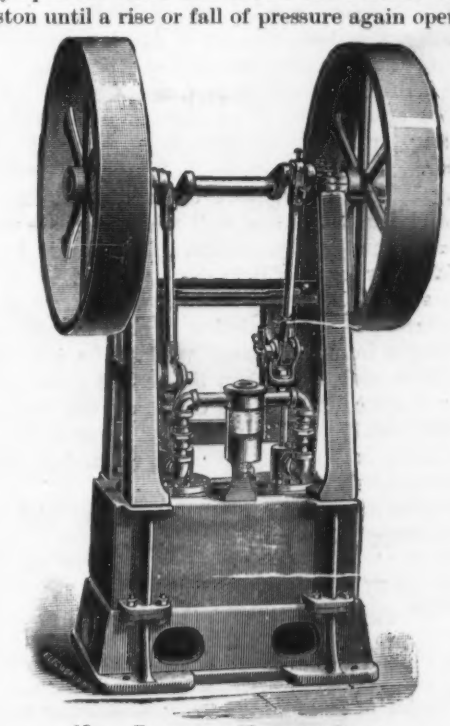
FIG. 1.—THE HOFFMAN DAMPER REGULATOR.

of a spiral spring, the other end of which is fastened to the bottom weight, on top of the piston.

The action of the regulator is as follows:

The valve being set by means of the lever and ball, when the steam pressure reaches the limit desired, steam is admitted through the valve into the cylinder, and moves the piston upward. The moment, however, that the piston moves, it pulls on the spiral spring that connects it to the short end of the lever and exerts a slight pressure that tends to close the valve and arrest further upward motion of the piston. If the amount that it closes the damper does not check the fire enough, the rising pressure will again move the valve and force the piston higher, until the increased pressure brought to bear on the valve by the further extension of the spring again closes the valve and holds the piston on the position attained. This is repeated until the damper is closed sufficiently to check the fire to the necessary point.

The reverse motion is effected in a similar manner. The falling steam pressure being unable to hold up the piston, it descends until the tension of the spiral spring is so reduced that the extra force that is exercised on the valve is lessened to that point where the steam pressure will slightly open the valve and arrest the further descent of the piston until a rise or fall of pressure again operates the valve, causing the piston to either rise or fall as the requirements may be. From this it will be seen that the damper is moved only as it may be required by the steam pressure, and only enough to meet the needs of the case. It will be noted that it is accomplished entirely in an automatic manner and without complicated parts. This regulator is placed upon the market by F. B. Aspinwall, manufacturing agent, of this city.



NEW PACKARD VACUUM PUMP.

Packard's Improved Vacuum Pump.

The high vacuum required in incandescent lamps necessitates the application of some form of mercury pump, such as the Sprengel or Geissler. But as these pumps are very slow in their action, the practice was early introduced of exhausting the bulbs as much as was possible by means of quick-acting mechanical vacuum pumps, and finishing the exhaustion by means of the mercury pumps.

Some time ago Mr. Norman Hubbard, of Brooklyn, N.

Y., introduced the Packard vacuum pump designed especially for this preliminary exhaustion of incandescent lamps, and recently improvements have been introduced which still further increase its efficiency.

The improved pump, which is illustrated in the engraving on page 118, is designed to give the highest attainable vacuum without the use of water in the cylinders, and to be capable of heavy continuous work. Our illustration shows a double pump, the cylinders being placed vertically in a cast-iron box, which serves as a bed-plate and water jacket, and on which the frame and working parts are mounted.

Each cylinder is entirely independent of the other, and they can be used separately or connected up as required. The suction pipes are connected at the bottom of the jacket by means of ground unions, which are provided with traps to arrest any mercury or dirt. The exhausts are also provided with traps to catch the oil used in lubricating the cylinders, which is thus saved and may be used over again.

The valve motion is on the principle of the well-known Ritchie valve gear, but greatly improved and simplified, containing none of its complication and liability to derangement. All the valves are opened and closed at the proper instant automatically, not requiring a pressure of air below them to do this work, and the main valve stem does not, as is usual with valves of this type, pass through the piston head. The piston packing is formed of leather rings and can be adjusted in case of wear. The clearance in the cylinders is reduced to a minimum, being gen erally less than one-sixteenth inch. No liquid is used in the cylinders, other than sufficient oil to insure proper lubrication.

As stated, these pumps, which are built in various sizes, are used by a number of companies for the preliminary exhaustion of the incandescent lamp bulbs and the jars used in heating carbons. Among these companies are the Sawyer-Man, Westinghouse, Thomson-Houston, Bernstein, Shaefer and a number of others. A 12×12 pump of this type is sufficient to operate 150 mercury pumps exhausting 3,000 lamps per day, a vacuum of 29½ inches being obtained.

The "Perfect Protection" Lightning Arrester.

The instrument here illustrated is automatic in its action, and resets itself after each static discharge. It conducts the static current to the ground without interfering in the least with the dynamos, lights or other devices in operation upon the lines. It is well known that where the lightning discharges from line to ground, the dynamo current instantly follows it, tending also to the earth from both sides. In the operation of the arrester, the arm is pivoted and made to rise from the jaw, thereby rupturing and destroying the new path for the dynamo current even before any loss from the line has occurred. After its work is done, this upper jaw is automatically restored to its former position. No shutting down is necessary, and the consumer knows nothing of the operation and is not annoyed by the extinction of his lights. It is self-setting, and once in position requires no attention whatever.

It requires no expenditure of current for its maintenance, and does its work as well when lines are not in operation as when they are, which, it is claimed, is not the case with other forms of lightning arresters.

The use of this lightning arrester will prevent almost all of the piercing of the insulation of electric light cables by static charges in underground work. The jaws being set much nearer each other than the nearest point to the core of the metallic coating of the cable, and the insulation between the jaws being air, which is a lower dielectric than the insulating substance of the cable, all rupture from such charges is entirely prevented.

This lightning arrester is placed on the market by the Electrical Supply Company of Chicago.

Care in Motor Testing.

BY FRANCIS B. CROCKER.

In a series of tests which Dr. S. S. Wheeler and I have lately been making on electric motors, we have been more than ever before impressed with the fact that each feature of a motor is capable of receiving, and deserves to receive, a great deal of the most careful study. Very interesting and valuable results may be obtained, not only by examining the motor as a whole, but also by subjecting each feature to a separate and close scrutiny. The career of the electric motor has been so extraordinarily short that there has not been time enough to give any consideration to its details, however much they may need it. It is a well-known fact—indeed, the statement of it is almost threadbare—that electrical science has been developed much more rapidly than any other important branch of knowledge. It will also be admitted, I think, that of all the parts of electrical science, the progress of that which relates to electric motors has been the most remarkable. Thus we may literally say that the electric motor has advanced at double-quick time; and such being the case it is inevitable that the work should be done in a careless, trust-to-luck fashion. The design of the motor has been largely guess-work; the construction has been "rushed," and the testing has been largely a matter of faith. The result of this reckless haste is often total failure.

We all know the deplorable frequency with which motor armatures have burnt out, and it is more than likely that the greater number of these cases are directly due to this excessive haste. But this undue abbreviation of time is not so much the fault as it is the misfortune of motor builders. On account of some unexplained peculiarity of human nature, men will wait for a steam engine to be

The "Perfect Protection" Lightning Arrester.

properly built, but they must have an electric motor "right away."

The time has now arrived, however, when more care can and must be given to motors, and I think, moreover, that there is a great deal of satisfaction as well as profit in doing this.

The three parts of motor building—designing, constructing and testing—are probably about equally important; but since the testing is the last operation, and can reveal errors in the other two, it is particularly worthy of attention, and I believe it is the one most neglected in the past. I shall therefore give a few points regarding it which are in the direction of more careful work.

In the tests to which I have already alluded, Dr. Wheeler and I have devised several things to facilitate our work. We have had a table prepared giving the electrical horse power for each volt and ampère, from zero to the ordinary limits of practice; also a table giving horse power at different speeds and torques. These and other tables enable us to instantly translate our results without interrupting our work. If one has to wait to go through laborious calculations the results lose their force.

These tables must be complete, and give each unit and fractions if possible. A table which skips by fives or tens is practically useless.

We also have a test card, a description of which I intend to publish later, on which are tabulated over 100 of the principal facts about a motor, and we find this of the greatest help in our tests.

Another very useful aid in our work, is a sheet ruled into squares, as ordinarily used for tracing curves, but made of convenient and uniform size with blank columns for observations on the side.

As an illustration of the use of this "curve sheet," I have given the accompanying results of a test of a small motor. This motor is series wound for a 10 ampère constant current circuit. In the diagram, the horizontal distances or abscissae represent the armature speed in revolutions per minute, and the vertical distances or ordinates on the left side represent power given in horse power, and on the right side in watts.

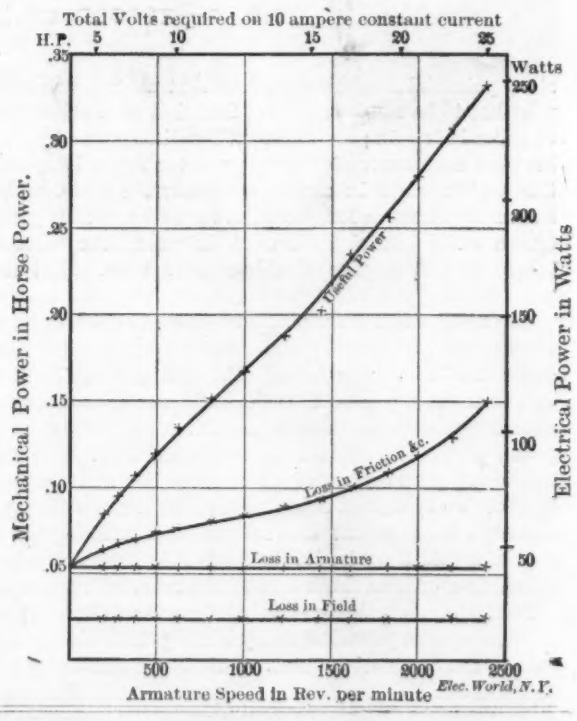
The lower horizontal line in the diagram represents the electrical power (C^2R) consumed in the field. This is constant, because the current is constant and the field resistance is constant. The distances between this and the second horizontal line represent the loss in the armature due to its resistance. This also is constant for similar reasons. The top inclined line represents the total power consumed in the motor at different speeds. At zero speed, it is simply the loss due to resistance in the armature and field, about .05 h. p., and increases almost uniformly to a maximum of .335 h. p. at 2,400 revolutions per minute. The power actually developed by the motor at different speeds, as measured by a Prony brake, is then laid off downward from the upper line, and this gives us another inclined line, and the vertical distances between these two inclined lines show the net power produced at any given speed. The total distances between the lower inclined line and the horizontal axis represent the total losses in the motor; and since the two horizontal lines represent the loss due to resistance in field and armature, the distance between the upper horizontal line and the lower inclined line represents all the other losses, chief among which are friction and Foucault currents. The most significant thing about the diagram is the rapid rise of the last named losses at high speeds. This way of representing the action of a motor we find very convenient and instructive. The relation between the different quantities is clearly shown. We also find it very desirable to give both watts and horse power, as sometimes one wants one and sometimes the other. We also give at the top the total E. M. F. consumed including the counter E. M. F. and fall of potential due to resistance.

I purposely selected a very small motor of only 1-8 h. p., in order to show that even this little machine deserves the most careful work.

CURVE SHOWING DISTRIBUTION OF ENERGY IN ⅛ H. P. MOTOR, 1 E. NO. 52. DATE, JAN. 9, 1890. SEE TEST NO. 156.

Observations.—Simple series-wound motor. Current constant at 10 ampères.

Arm. Speed	E. M. F. used.	Power supplied.	Power developed.
Revolutions per minute.	Volts.	Watts.	H. P.
0	4.	40	0.
200	6.2	62	.02
300	7,1	71	.029
400	8.	80	.038
500	8.7	87	.047
600	9.8	98	.055
800	11.5	115	.071
1,000	12.5	125	.086
1,200	14.2	142	.100
1,400	15.1	151	.113
1,600	17.7	176	.136
1,800	19.2	192	.148
2,000	21.	210	.160
2,200	23.	230	.170
2,400	25.	250	.180



TEST CHART OF ONE-EIGHTH HORSE POWER MOTOR.

Progress of the West End Power Station in Boston.

Probably there is no piece of electrical engineering in the world which is attracting more attention among the electrical fraternity, and, indeed, among the general public, than the immense power station now in process of erection in Boston by the West End Street Railway Company, under the erterprising management of Mr. H. M. Whitney, whose name is rapidly becoming known as a leader in progressive ideas. When it was determined, a few months ago, to adopt electricity on a large scale in Boston, it was at once seen that some temporary power station must be arranged to supply current for the large increase of cars which it was proposed to put in service this winter. This temporary station, which is located on part of the site which will be occupied by the permanent station, is illustrated in the accompanying engraving, page 115, as it in itself is probably one of the largest—if not the largest—electrical power stations now in existence.

The temporary power station occupies a portion of the old factory of the Hinckley Locomotive Works, and does not present any special features as a building. In the boiler room are four Babcock & Wilcox boilers of 250 h. p. each, carrying a pressure of from 140 to 160 pounds of steam per square inch. Three of the four boilers are generally in constant use, but all four are required during the heaviest load. A ten-inch wrought-iron pipe line conveys the steam to the engine room. In the boiler room is also situated a Knowles feed pump and two Hancock inspirators for feeding the boilers, and there is a floor space capable of holding about 75 tons of coal, which is brought from the wharf some 200 yards away by means of an electric tramway.

This wharf has capacity for five or six lighters, and will be of the utmost convenience when the power house is completed, being fitted with steam crane and all conveniences.

In the engine and dynamo room, as will be seen by a glance at the cut, are five 300 h. p. McIntosh & Seymour compound condensing engines, running at a speed of 205 revolutions per minute. Each engine drives three compound wound generators of the Thomson-Houston railway type, at distances of 10, 15 and 20 feet between centres, each generator being capable of developing 500 volts and 120 ampères, producing 80 h. p. The load is lightest from about 9.30 A. M. till noon, but frequently all five engines and 15 generators are required during the busiest part of the day. The illustration shows the arrangement of the generators, and it will be noticed that three generators are of the new type, being substantially of the same type as will be used in the permanent station. These generators are each of 100 h. p. capacity, and are of the multipolar type, having four poles, with a Gramme ring armature. This illustration also shows the general disposition of the switchboard which, though entirely different from the switchboard which will be constructed for the permanent station, is yet a most complete arrangement, and is extremely interesting in detail. At the extreme end of the switchboard may be seen a potential board, used in testing the electromotive force of each generator before switching into the circuit. Only one voltmeter is used, but by means of this board any generator can be tested, by revolving the switch into its corresponding terminal points. The two poles of the generator come to a set of contact points ranged in a circle, the positive and negative points of each generator being set radially, and the two terminals of the voltmeter are brought to concentric rings. The switch bears always on the rings, and it also has a set of contacts for touching the terminal points of each generator. At the bottom of the switchboard are 15 rheostats, in series with the field of the generators for regulating the potential. Immediately above are 15 three-point knife switches, one for each generator. The right-hand point is connected to the positive wire from the dynamo, and leads through the switch to the positive bus wire, which is connected through detachable connectors, shown on top of the switchboard, to the eight feeders which supply the current to the trolley wire. These feeders are afterwards subdivided outside into fourteen different feeders, running to various parts of the city.

The left-hand point of the switch is connected to the negative wire from the generator, and through the switch to an ammeter, one for each dynamo, thence to a circuit breaker, thence to the negative bus-wire on the back of the switchboard, which in turn is connected by underground cables to the rails, to water-grounds sunk between the rails in various parts of the city, and also to large copper plates submerged in the waters of the South Bay. The middle point of the switch is connected to a positive wire from the generator, direct from the brushes, before it enters the series coil of the compound winding; and through the switch this wire is connected to a common equalizing bar, so that the positive brushes of each generator are in metallic contact, preserving an equal potential on each generator. The circuit-breakers are electro-magnetic in their action, and any undue increase over the normal current at once breaks the connection and cuts out the generator. These circuit breakers are set to cut out the generators at about 160 ampères. The contact of the switch in these circuit breakers is made between the jaws of the electro-magnets, and the lever of the switch is held in its place by a small attachment on the armature of the magnet. As soon as too great a current is generated, due to a grooved or short circuit, the armature is attracted, the lever is released and the switch is pulled open by springs, no perceptible arc taking place. A long lever with an arm for each circuit breaker is fitted to the board for the purpose of cutting in all the generators simultaneously. The generators are all designated by corresponding numbers on the switchboard, and any generator can be cut in or out, independent of which engine it is connected to. At the extreme right of the switchboard provision has been made for a large ampère meter, which will show the total number of ampères and which will be inserted in the negative or ground return wires.

Leaving the dynamo room and stepping outside, a busy scene meets the eye of the spectator. At first we can barely realize what is going on, but after a little inspection one can trace out the plan of the foundation work for the permanent station. Nearest to Harrison avenue, and abutting against the temporary station, is a large square excavation which is now nearly filled up with piles, and partly covered with concrete. This is to form about one-half of the immense solid foundation bed for the engines and counter-shafting, and measures at present about 160 feet in length by 170 feet in width. In this square there have been driven about 3,700 spruce piles 14 inches in diameter at top, 45 feet in length, there being three feet between their centres across the work, and 2½ feet between centres in the direction of the length of the building. These piles protrude above the soil about five feet, and then concrete has been filled in all around them and to a depth of one foot on top, making, in the engine room, a total depth of six feet of solid concrete.

Under the chimney stack there are some 800 45-foot piles, set at a distance of 30 inches between centres. Here there is four feet of solid concrete, three feet around the piles and one foot on top of the piles. The walls of the building will be two feet six inches thick in the engine room, and two feet thick in the boiler room, and a treble row of piles has been driven all round for the foundation of the walls, making about 850 piles. In the boiler room, each battery of boilers is hung from six piers, and there are four piles under each pier, making in all in the boiler room some 300 piles. Under the economizers, feeder room and pump room there will be about 50 more piles.

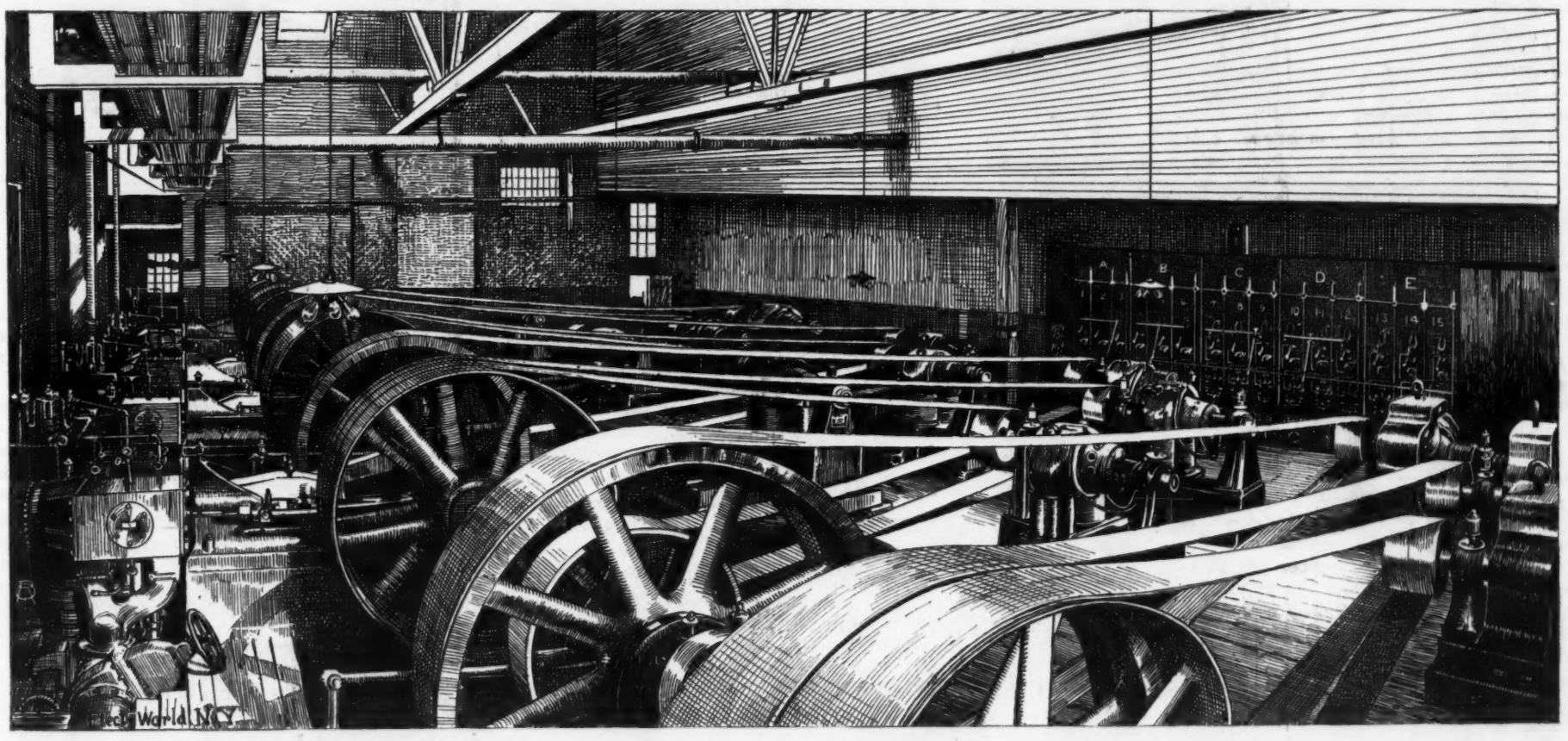
From the power house to the South Bay will be run a double line of 3-foot cast-iron pipe for condensing water, and the foundations of these pipes will all be piled. In all there will be about 6,000 piles used at present, though the remaining half of the engine room will require from 3,000 to 4,000 more. The necessity for such a large amount of piling has been caused by the nature of the soil, as it is all made land on top of a bed of soft clay, dock mud, shells, etc., composing the old flats surrounding the South Bay.

There are at present from 275 to 300 men engaged on the foundation work, and the work requires about 200 barrels of cement per day. The concrete is composed of five parts of broken stone, two of dried sand, and one of Portland cement, and each barrel of cement is tested. There are about 5,500 cubic yards of concrete, making about 10,000 tons in weight.

In order to understand the necessity for such a solid foundation, a few figures about the plant may be found interesting. There will be thirteen 1,000 h. p. Reynolds-Corliss triple expansion engines, built by Edward P. Allis & Co., of Milwaukee, Wis., with Allis surface salt water condensers, with high pressure and intermediate cylinders, tandem fashion, with one piston rod, and the low-pressure cylinder by itself on the other piston rod, with the fly wheel between, weighing complete about 100 tons. The condenser will stand at the side of each engine. The cylinders will be 28, 36 and 52 inches in diameter respectively for the high, intermediate and low pressure, with a four-foot stroke. The crank shaft will be 17 inches in diameter and will carry the fly wheel, which will be 28 feet in diameter by 10 feet 7 inches face. The fly wheel, which will be cast in ten sections, will weigh 140,000 pounds in the rough, but when finished will weigh 130,000 pounds. Each engine will rest on 12 feet of solid granite masonry and 9 feet of brick work, making the bed of the engine 21 feet from the surface of the concrete.

The countershafting, which will be 9 inches in diameter, and which will be fitted with clutch pulleys throughout, will rest on seven feet of granite masonry, and will be driven by two belts on the same pulley 5 feet in width. Plain leather belting will be used and Charles Ireson, of Boston, is now engaged making it. Each generator of 250 h. p., of the multipolar type, on the floor above, will be driven from the countershaft by means of a 32-inch pulley with a 30-inch belt. These generators stand 4 feet 4 inches high from floor to centre of shaft, and will be about 8 or 9 feet high over all.

The smoke stack will be 250 feet high, circular in form 26 feet diameter at base, and 17 feet diameter at the top and will be of the double brick shell type, having a uniform flue of 13 feet. It will rest on 16 feet of granite masonry composed of four courses 24 inches thick, three courses 20 inches thick and two courses 18 inches thick. There will be about 1,100,000 bricks used in the construction of the stack, and it will weigh about 2,800 tons, the foundation work weighing about as much more.



DYNAMO AND ENGINE ROOM, WEST END ROAD, TEMPORARY STATION, BOSTON, MASS.

The boilers will consist of twelve batteries of Babcock & Wilcox boilers, of 500 nominal horse power each, though each will be capable of furnishing steam to supply 1,000 h. p. at the engine. The main steam pipe will run directly through the middle of the generator room, and will probably be about 21 inches in diameter at first, getting smaller as it passes each engine. A five-inch pipe will supply each engine, and all the steam piping will be covered by some non-conducting material. As soon as the permanent station can be started, the temporary station will be abandoned, and excavations commenced for the extension of the power house.

The West End Street Railway Company are also at work erecting a power house in the Cambridge district, of 4,500 h. p. which will be very similar, though smaller, to the Harrison avenue station, and are now running a 1,000 h. p. station at Allston. When all are completed there will then be about 18,500 h. p. capable of being transformed into electric energy for the propulsion of a vast system of street railways, an enterprise which we venture to say has no parallel as yet in the history of electricity.

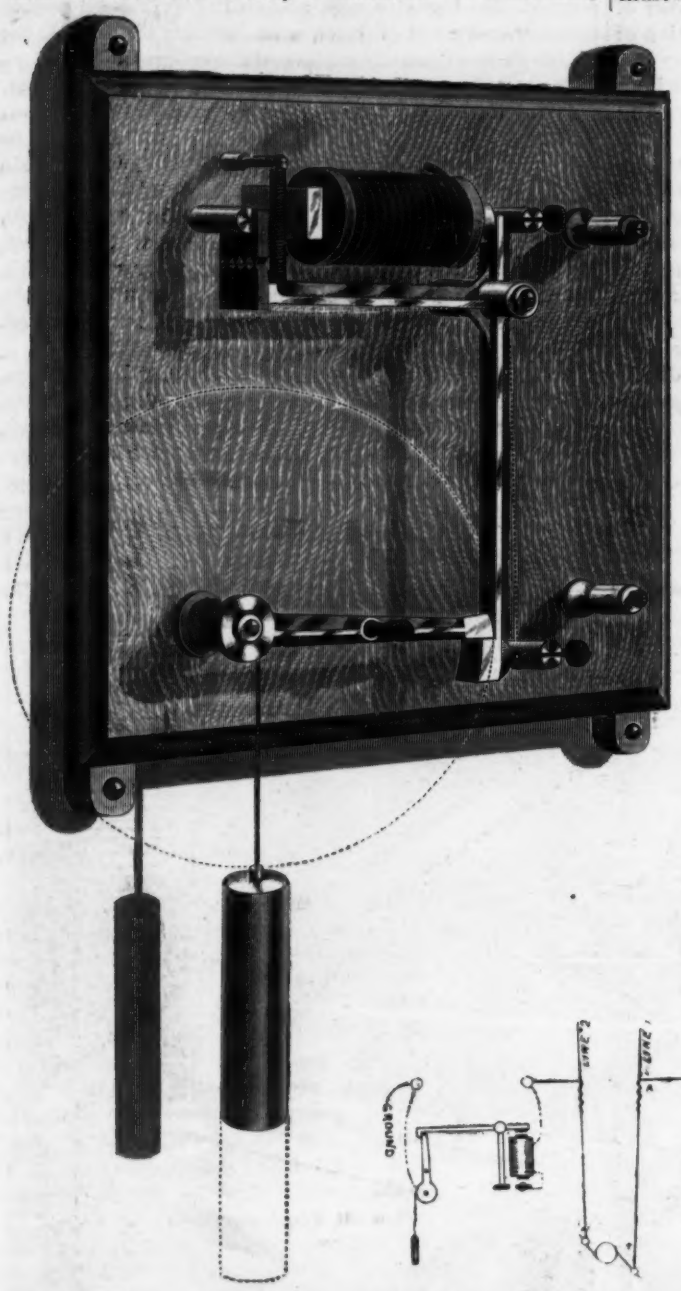
The whole work is under the immediate supervision of Mr. F. S. Pearson, while Mr. L. S. Dumoulin has charge of the electrical department, and we may add that the West End Company have just secured the services of Mr. L. J. Hirt, formerly mechanical engineer of the Hill Clutch Works, and a gentleman of long experience in the mechanical designing and erection of electric light and power plants, as chief engineer of the steam department. These gentlemen are busy preparing new designs for the feeder room fittings and switchboard, which will be en-

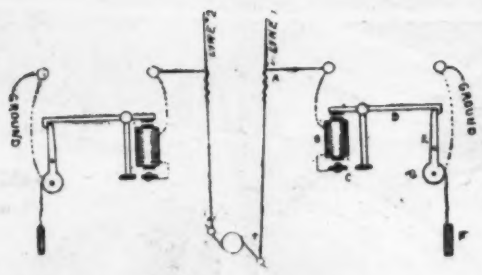
tirely separate from the generator room, and which will be the most complete thing of the kind in existence.

At present there are some 200 cars running by electricity in Boston, but we may expect inside of a year to see every car in the city and suburbs propelled without the assistance of horses, whose term of usefulness for street car work is rapidly drawing to a close in Boston.

The "Central" Lightning Arrester.

The lightning arrester illustrated in this article, Figs. 1 and 2, presents some new features in instruments of this kind that seem to be worthy of attention. It is necessary





FIGS. 1 AND 2.—CENTRAL ELECTRIC LIGHTING ARRESTER.

with this arrester, as with others intended for the protection of metallic circuits, to place one on each side of the dynamo, but the objection to this has been the danger of short-circuiting the dynamo through the two grounds in case the arrester points became fused together—a danger by no means to be overlooked. Another feature that will be appreciated is the impossibility of an equilibrium being established between the magnet and the arc drawn at the point of separation, for the points begin to separate the instant the magnet is acted upon, and immediately there follows a complete and absolute break of the arrester circuit.

The surplus or "wild" charge coming in on line 1 leaves the line at *A*, passes around the electro-magnet *B*, jumps across the carbon points *C*, through the levers *D* and *E* to ground. The dynamo current, following the atmospheric discharge, passes around the electro-magnet *B*, acts upon the same and attracts the armature of the lever *D*, which, in turn releases the lever *E*. The moment the lever *D* starts on its journey the carbon points *C* begin to separate, thus preventing their fusing together, as they would be liable to do were they fixed.

When the armature approaches *B* sufficiently, the arrester circuit is entirely broken by the lever *E* flying out of engagement with *D*, where it is held by the weight *F* suspended by a string wound around the drum *G*. Upon this breaking of the arrester circuit, *B* loses its magnetism, the lever *D* falls back into position and engages the lever *E*, after the same has described a circle. The arrester is then set for the next discharge, and can take discharges in rapid succession until the weight runs down. When this occurs it can be quickly and safely wound up again by turning the lever *E* in the reverse direction, the lever being provided with an insulated handle for that purpose. This action also applies to line No. 2, the connections on both lines being identical.

This arrester is being introduced by the Central Electric Company, of Chicago.

The Harmount District Telegraph Box.

In the business of a district telegraph company, as in any other enterprise, faults and troubles will arise, the most fruitful source of which is the subscriber himself. Not every one is born an electrician, neither is every one born a mechanic, but many people are ready to find fault with the matters and things with which they are brought in contact, though they themselves could do no better, and would probably do much worse.

To be successful, any business which deals with the general public must be popular, and in order to be popular, must be able to meet every requirement of an exacting clientage. To avoid the little annoyances which it is claimed, have been occasioned by the old patterns of district telegraph boxes, a new box has been recently patented and placed on the market.

The chief characteristic of this box is a series of push buttons, the name of a "want" being printed on each button, and the principle on which it works is that of a divided circuit. It contains the ordinary mechanism of a district telegraph box, having but one commutator wheel, with the notches in its periphery corresponding to the number of the box, and ten notches to correspond with the ten different wants. At a given point in the revolution of this commutator wheel, which corresponds to the relative position of each push button, the brush may be shunted. Hence, the number of dashes will be sent in which will correspond with the button which has been pushed down. The box is so constructed that when one button is pushed in, any and all other buttons which may have been pushed in at that time will be released and return to their normal position. It is next to impossible for a mistake to occur on this box, for a person has but to put his finger on the button on which his want appears and press it down.

The return signal on this box is very simple, yet complete. There are two windows, at one of which will appear (when the box is in working order) the words "in order." When the signal has been sent in, the operator at the central station, by pressing a double contact button, breaks the circuit, depriving the line for an instant of all current.

This causes to appear in the other window in every box on that line the word "answered," which remains in the window for an instant and then disappears, the words "in order" appearing at the other window. This notifies the one who sent the message, and all others on that line, that a certain call has been made and has been understood. This makes the box practically non-interfering, as when any box is in use the indicators in all the other boxes will be moving. The answer back is given in all the other boxes, after which the box will show the words "in order." Then any other subscriber who may have been waiting will know that the line is in order and can be used.

The mechanism which short circuits the box is simply a small brush attached to each push bar. This brush, when the bar is pushed in, is held down to such a position that when the proper place on the commutator wheel shall have reached the brush, it will make a contact that will short circuit the breaking mechanism. The pushes on the box are made large enough to have the entire wants spelledout if necessary.

The box was patented January 7th, 1890, Patent 418,778, and is now being put on the market by G. A. Harmount, Manager of the Monitor Electric Company, Chicago, Ill.

A New Universal Tin Shade.

The shade illustrated in this article is designed especially for use in mills, factories, machine-shops, billiard-rooms and places where a more expensive porcelain or glass shade is liable to be broken or damaged. It is stamped out of a single piece of tin painted a light green on top, having a bright tin under, or reflecting surface. The corrugations help to diffuse the light evenly and give the shade a finish.

The No. 1 shade is designed especially for the Edison socket, which it fits perfectly without a holder, while the No. 2 shade fits any socket in the market besides the Edison. There is a brass collar closely fitted around the rim of the No. 2 shade, having adjusting screws arranged to securely fasten the shade to the socket.

These novelties are being introduced by the Central Electric Company, Chicago.

Testing the Interior Electrical Conduit.

At the invitation of the Interior Electrical Conduit Company a large number of prominent gentlemen gathered at the works of the Bergman Electric and Gas Fixture Company, in this city, on Friday last, in order to witness some experiments designed to show the efficiency and convenience of the "interior conduit," this latest advance in electric lighting. Our columns have recently contained a full description of this notable improvement, and we need therefore only point out that the system consists in providing a regular system of conduits or tubes within houses in the same way as gas pipes are provided for the distribution of gas. These tubes are made of a practically non-combustible compound, and through them the wires are drawn to each floor, chandelier or bracket as required.

Mr. E. H. Johnson, who conducted the experiments with the assistance of Messrs. E. T. Greenfield and J. H. Vail,

FIGS. 1 AND 2.—TIN SHADES FOR ELECTRIC LAMPS.

explained to the assemblage the construction of the tubes, and the manner of their arrangement was clearly seen in the conduits distributed about the room and in which the wires feeding the lamps there burning were run.

In order, first, to demonstrate the ease and rapidity with which wires can be run through the tubes, a section of ⅜-inch tubing having two elbows was employed. A narrow steel tape containing a peculiar head, tipped with small rollers, was easily pushed through the tubing and around the elbows and emerged at the other end. A cord was then attached to the end of the steel tape and, after being drawn through the tube, served to draw in the wire after it; the whole operation taking almost less time than this recording of it, and in marked contrast to the tedious

HARMOUNT DISTRICT MESSENGER BOX.

process of "fishing," so often done in house wiring at present.

Mr. Johnson then explained the dangers to which wires in houses are subjected, arising from three causes, viz.: overloading, short circuits and leakage. He pointed out the fact that it was the latter which was the most dangerous and the one heretofore least guarded against. Thus a leak might carbonize the material surrounding the wire and form a dangerous arc without blowing the safety fuses, and thus start a fire. To guard against this, the plan has been adopted by the company of employing, in connection with the tubing, cir-

cuits in which the two wires, covered with good cotton insulation, are twisted together, and then covered with thorough waterproof insulation, and then braided. By thus placing the two sides of the circuit in close proximity to each other, a leak must immediately develop into a short circuit, by which the safety plugs are blown at once, and the current shut out from the circuit. The formation of dangerous arcs through leakage is thus avoided; and an actual experiment made in the presence of the visitors showed the undeniable truth of the assertions made and the efficacy of the means adopted to guard against this danger.

A number of experiments were then made to demonstrate the effect of an overheated wire on the tubing. For this purpose a circuit was made consisting of a wire, half of which was suspended in the air and the other half run through the new tubing. On passing a heavy current through this circuit, the part suspended in the air set the insulation rapidly to smoking, and finally set it in a lively blaze. During this time smoke could be seen issuing from the tube, but no sign of flame was observed. After the rupture of the wire, caused by the fusing of the air-circuit, had stopped the current, the tubing surrounding the other half of the circuit was cut open, and disclosed the rubber insulation of the wire completely charred and reduced to ash, but the surrounding tape almost unaffected. The interior of the tube itself, however, showed absolutely no sign of deterioration or damage whatever. This is easily accounted for when we consider that the small amount of air contained within the tube is rapidly exhausted by the combustion of the rubber, and the ash surrounding the hot wire acts as an excellent non-conductor of heat. A number of other interesting tests were made with the tubing, all of which confirmed its admirable qualities.

Finally, Mr. Johnson read a report of a test made by Mr. A. E. Kennelly, at the Edison laboratory, for the purpose of showing the insulating properties of the tubing. The report showed that a length of tubing, such as ordinarily made, gave, after three weeks' immersion in water, an insulation resistance of 15 megohms, or about 40,000 ohms to the mile. Thus, while not depended upon whatever for insulating the wire, the tubing itself affords practically absolute protection against dampness and moisture.

The experiments as stated above were witnessed by a distinguished gathering, among those present being Mayor Hart, of Boston; Colonel Parker and several other members of the Boston Common Council; Mayor Newhall, of Lynn, Mass.; Mayor Pingree, of Detroit; Mr. C. F. Killicutt, of the Boston Fire Underwriters; Mr. W. H. Saywood, secretary of the Boston Builders' Association; Mr. Murphy, of the Boston Fire Commission, Mr. F. W. Whiting, secretary of the Philadelphia Board of Fire Underwriters; Professor Barker, of the University of Pennsylvania. Among the others present were Messrs. P. H. Alexander, W. J. Jenks, F. S. Hastings, L. Stieringer, J. H. Vail, H. L. Barclay, and Dr. W. E. Geyer.

On the conclusion of the experiments those present were invited to the Hoffman House to partake of what had been designated as a plain lunch, but which turned out to be a most enjoyable and interesting banquet. Mayor Hart, of Boston, presided, and in his opening remarks stated that he believed the question of safety to interior wires was practically solved, judging from the experiments he had seen. Several other speakers made remarks apropos to the occasion, and all agreed that the tests made by Mr. Johnson were eminently "fair" and free from that suspicion which not infrequently attaches to "tests" of this nature. The company disbanded with a vote of thanks to the company and its president. It is safe to say that the exhibition thus given was one of the most interesting and important that has taken place in this city in connection with electric lighting and power.

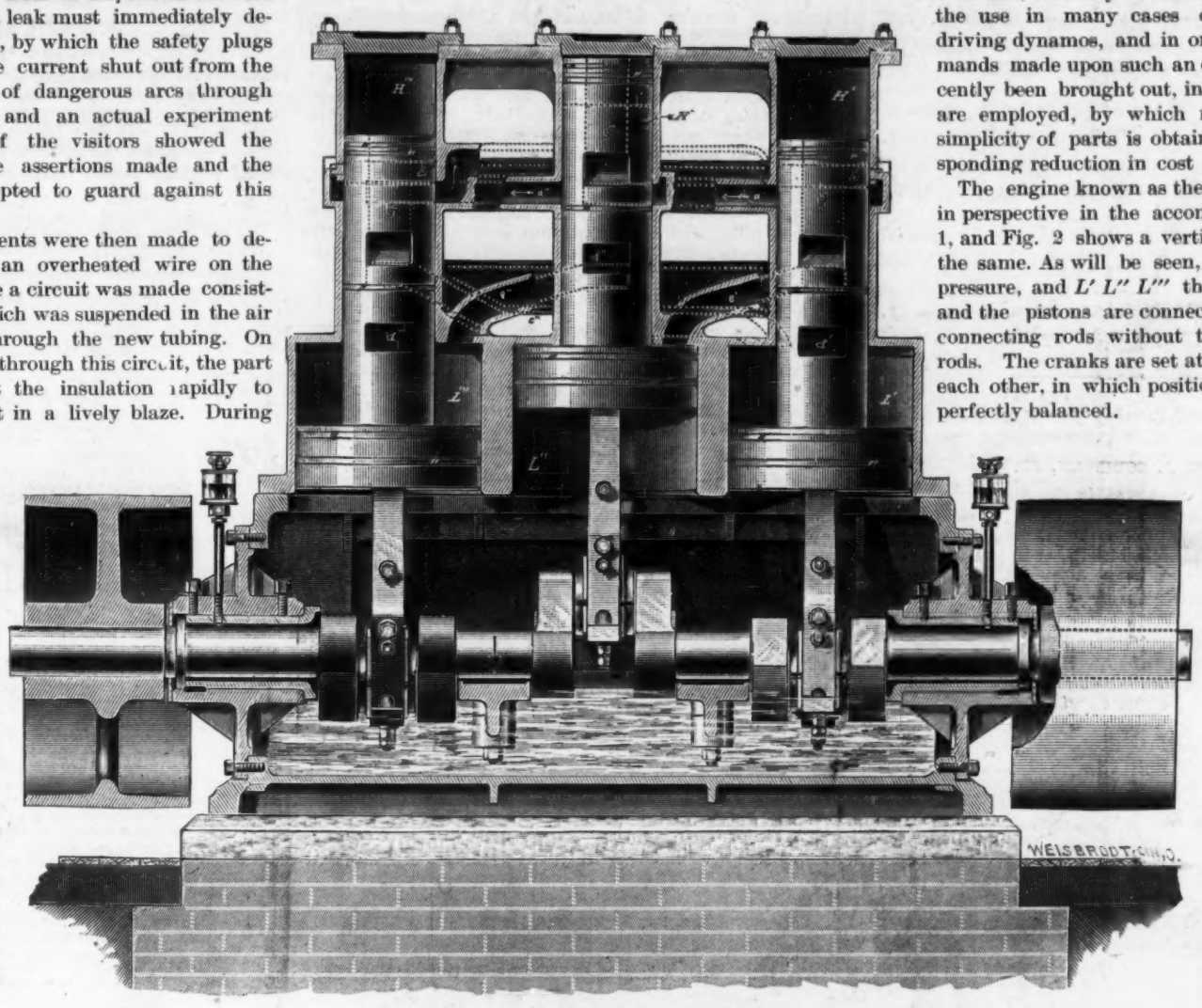


FIG. 2—THE "TRIUMPH" COMPOUND ENGINE.

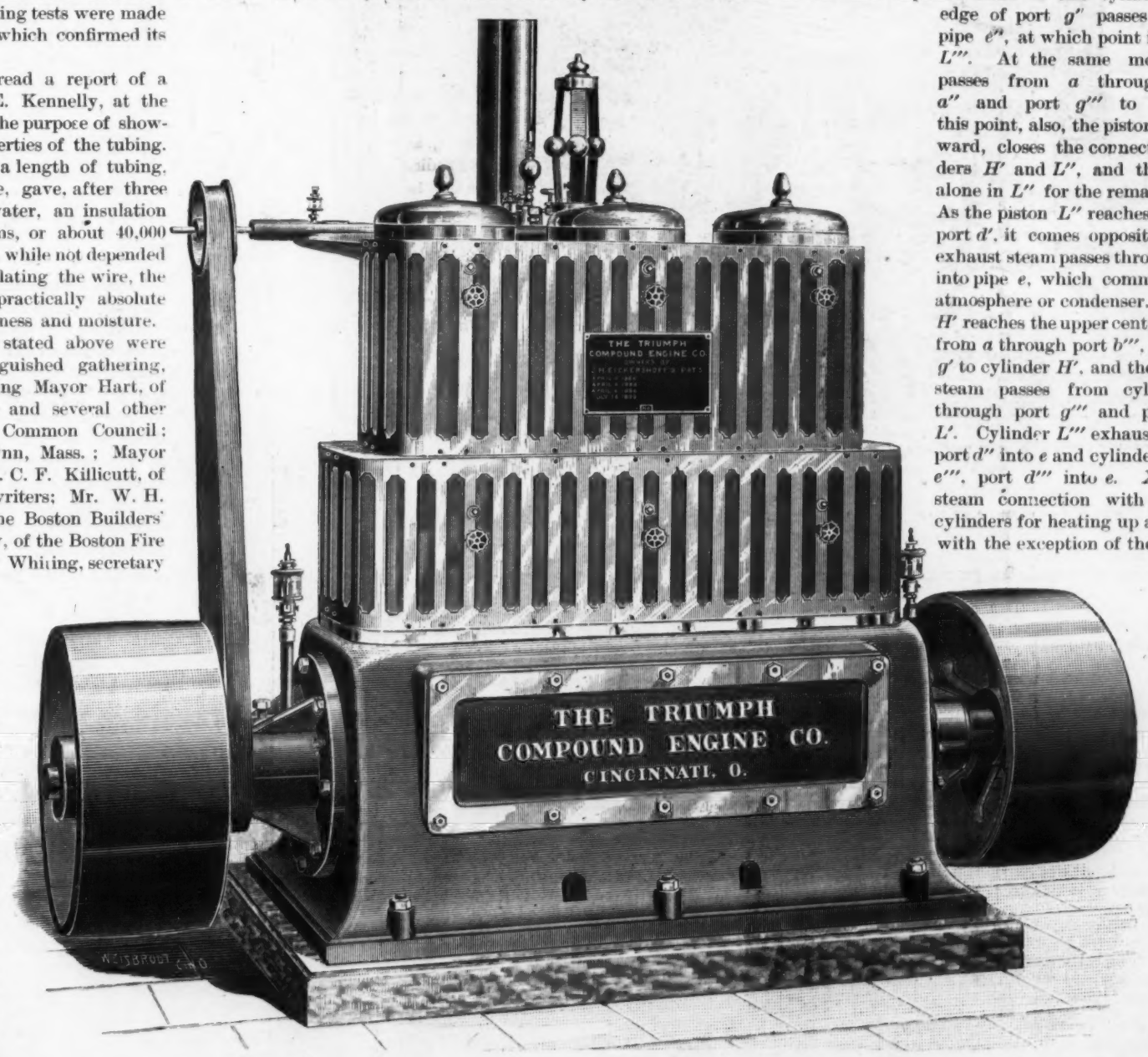


FIG. 1.—THE "TRIUMPH" COMPOUND ENGINE.

The New "Triumph" Compound Engine for Electric Lighting.

Of late, economy in steam consumption has led to the use in many cases of compound engines for driving dynamos, and in order to fulfill all the demands made upon such an engine, a new type has recently been brought out, in which no valves, as such, are employed, by which means it is claimed great simplicity of parts is obtained, together with a corresponding reduction in cost of repairs and attendance.

The engine known as the "Triumph" is illustrated in perspective in the accompanying engraving, Fig. 1, and Fig. 2 shows a vertical longitudinal section of the same. As will be seen, H' H'' H''' are the high pressure, and L' L'' L''' the low pressure cylinders, and the pistons are connected directly to the shaft by connecting rods without the intervention of piston rods. The cranks are set at an angle of 120 deg. with each other, in which position all the moving parts are perfectly balanced.

The piston of cylinders H'' and L'' are shown on the upper centre, those of H' and L' being 120 deg. in advance and those of H'''' and L'''' 120 deg. in the rear. In this position live steam is admitted from the main steam pipe a through port b', pipe a' and port g'' to cylinder H''; and at the same instant steam which has been partly expanded in cylinder H', passes down through port g' and pipe e' to cylinder L', thus admitting live and low-pressure steam on one set of pistons at the same instant. Under the action of the steam pistons, H'' and L'' move downward, live steam being admitted until the upper edge of port g'' passes the lower edge of pipe a', at which point it is cut off and expands alone in this cylinder, until the lower edge of port g'' passes the upper edge of pipe e'', at which point it passes to cylinder L'''. At the same moment live steam passes from a through port b'', pipe a'' and port g''' to cylinder H'''. At this point, also, the piston of H', moving upward, closes the connection between cylinders H' and L'', and the steam expands alone in L'' for the remainder of the stroke. As the piston L'' reaches the lower centre port d', it comes opposite pipe e', and the exhaust steam passes through this connection into pipe e, which communicates with the atmosphere or condenser. When the piston H' reaches the upper centre live steam passes from a through port b'''', pipe a'''' and port g' to cylinder H', and the partly expanded steam passes from cylinder H''' down through port g''' and pipe e''' to cylinder L'. Cylinder L''' exhausts through pipe e'', port d'' into e and cylinder L' through pipe e'''', port d'''' into e. X is merely a live steam connection with the low-pressure cylinders for heating up and starting. Thus, with the exception of the cut-off, each set of pistons controls the steam in the cylinder next preceding, in the order of rotation, and, when acting as a valve, is at, or near, its maximum speed, while the piston in the preceding cylinders are at, or near, their slowest speed. This simple expedient controls the steam in this engine in a manner to give the highest economy.

All lubrication is perfectly automatic, consisting of a sight feed lubricator on the steam pipe, a drop sight feed cup on each end bearing of the shaft and a mixture of oil and water in the crank case, perfectly lubricating all parts within. The cylinders are cast in

one piece and bored at the same time on a tool especially designed for the purpose, by which means they are made absolutely parallel and the danger of leaky joints avoided.

The bearings for the shaft are bored out after being bolted in place, insuring perfect alignment, and all wearing surfaces are exceptionally large, so that internal friction is reduced to a minimum.

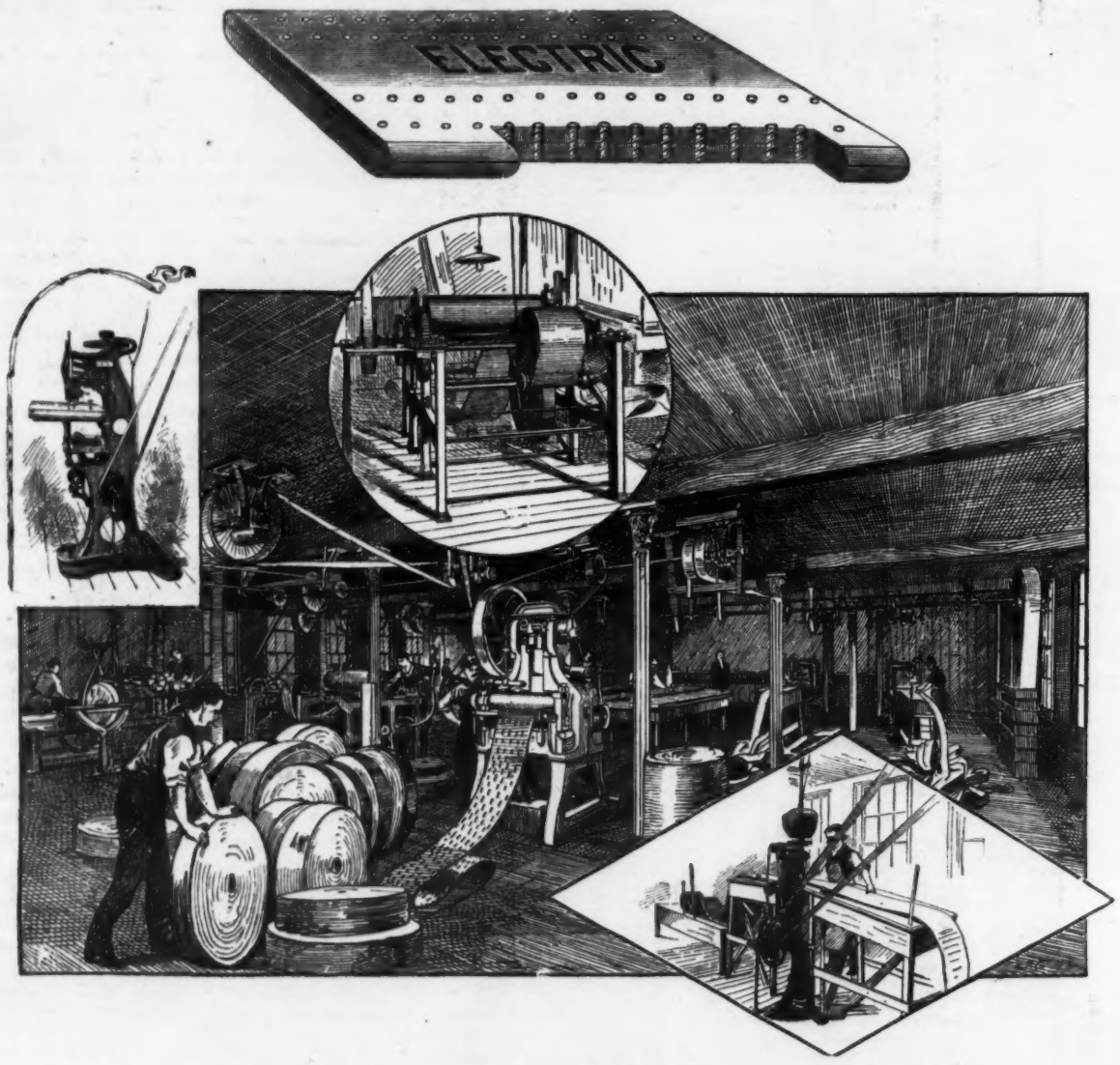
The only adjustments consist of two keys in the connecting rods which take up all the wear in both boxes. The pressure being always downward these adjustments are seldom necessary and the engine will run indefinitely without stoppage.

The builders of this engine, the Triumph Compound Engine Company, of Cincinnati, O., fitted their shops with special tools designed for this work, and have given considerable attention to the feature of interchangeability, wherever practical using guages and templets.

The Manufacture of Belting for Dynamos.

BY CHARLES A. SCHIEREN, JR.

While electric lighting was yet in its infancy, it was found that the ordinary run of belting was unsuited for dynamo transmission. Belt makers began to study the requirements of electric light machinery, and found that a belt was needed which should be of a perfectly even substance throughout, combined with pliability and strength.



FIGS. 1 AND 2.—THE MANUFACTURE OF BELTING FOR DYNAMOS.

Many experiments were made in preparing these belts, both as to the quality of the leather used, and as to improvements in the currying process. It was found that in consequence of the high rate of speed at which dynamos were run, and their being exposed to mineral oil which penetrates the leather and rots the fibre, the life of the belt was materially lessened. To overcome this difficulty, a dressing or composition was invented, which, if put on the surface of the belt after it is made up, renders it impervious to all oils or liquids of any kind, and makes the belt as near water-proof as leather can be made. This dressing is, I may say, what makes the life of Schieren's "Electric" belt at least four times that of an ordinary belt.

It was also found that the rivets or fastenings generally used were too cumbersome and injured the running of a dynamo belt. To overcome this, the house adopted the method of using *endless copper wire screws*, which are screwed into the belt and cut off short at both ends, leaving the surface perfectly smooth and at the same time holding the leather firmly together.

When the alternating current system made its appearance, and belts had to be run as high as 10,000 feet per minute, it was found that many belts would not stay on the pulleys at all; and, if they did stay on, would run with a sort of waving, vibrating motion, and form air cushions between the belt and pulley, consequently the dynamos could not be held up to their speed. After many experiments Mr. Schieren conceived the idea of simply perforating the belts with holes in a systematic manner, so as to produce a perfect tension and even strain all over the surface of the belt. A large machine was constructed which can perforate a belt of any width whatever at the rate of 1,000 feet per hour.

This invention proved to be a great success, and during the past two years, thousands of these belts have been made by this firm, and are running in all parts of the country. They have been tested in various ways, and in the most difficult positions, and have been subjected to the greatest strain, but have withstood all tests.

The Denver, Col., Light, Heat and Power Company have 21 "perforated" belts in operation. Some of them (16-inch) are running 8,000 feet per minute, developing 160 h. p. They were put on the pulleys two and a half years ago, and are apparently as good to-day as when put on. The perforations in these belts, besides preventing air cushions from forming between belt and pulley, allow them to be run looser than ordinary belts, with less strain on dynamo bearings and the consequent use of less oil.

In order to insure success and avoid any possible cause for failure the firm uses nothing but the centre part of prime steer hides in making up these belts. The leather is all pure oak tanned, stretched on the latest and most improved plan, and anything that can be done to still further improve the quality of these belts, is done irrespective of expense, in order to retain the high standing which they now have in the market, and to make the quality still better if possible.

To all those who are interested, and desire to see how belts are made, and what care is given in selecting the stock, we cheerfully extend an invitation to call and see our facilities. The inspection of a belt factory is calculated to bring out many details of great interest and value to an electric light man, and the points I have touched on are but a few of those which suggest themselves.

A New Insulating Staple.

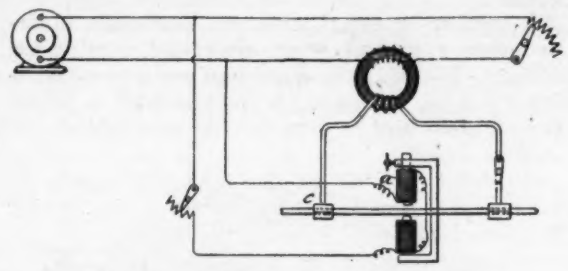
Heretofore in the wiring of buildings and other structures for electric lighting and other purposes, where the wires are run along the wall or other surface, it has been customary to employ, for securing the wires, double-pointed metal staples, which are driven in over the wires, so that their curved heads fit upon the wire and hold the same in place. With this arrangement difficulty has arisen, because the metal of the staple is liable to come into contact with the wire, sometimes by the abrasion of the insulating-covering of the wire by the staple, and also when the insulation becomes deteriorated in use by exposure or otherwise. Such contact of the metal staple with the wire is likely to result in leakage and ground-connections, and hence the use of the bare metal staple may become a source of danger. To avoid this, Mr. Luther Stieringer, of this city, has recently designed a staple which, as shown in the accompanying illustrations, consists of the usual metal staple, but having in addition a saddle of insulating material firmly attached to it. Thus, when the staple is driven, the wire is held in place by the comparatively large surface of the insulating saddle. As a result, this staple can be driven as hard as desired without fear of bringing the metal of the staple in contact with the wire. This staple, which has recently been patented, is a decided improvement, and machinery is now in course of construction which will shortly be able to turn out quantities large enough to meet the demand.

Electro-Magnetic Metal Working.

To the Editors of The Electrical World:

In the issue of The Electrical World for Feb. 1, 1890, I notice an editorial entitled "Alternating Current Phenomena." In that article you refer to a recent patent granted to Mr. C. L. Coffin, wherein magnetism is employed in electric welding. I have discovered that magnetism properly applied to a part of a metal bar or blank to be worked, or at the point of contact of two or more metal pieces to be welded together, increases the resistance or stress at such point, and requires a current of much smaller volume to accomplish the heating of the part than would be otherwise required, and economizes in various other ways.

Such discovery is set forth in Patent No. 408,875, granted to me Aug. 13, 1889, about a month before Mr. Coffin's application for his patent was filed. Although I did not illustrate a welding operation in the drawing of my patent, I illustrated many similar operations, and stated in my specification that: "It will be obvious that it may be advantageous to employ magnetism in some cases for all forms of electric metal working, including welding, tempering, etc."



ELECTRO-MAGNETIC METAL WORKING.

It will be seen, therefore, that my prior patent discloses the employment of magnetism in the same way and for the same purpose, among others, as disclosed in Mr. Coffin's patent.

MARK W. DEWEY.

SYRACUSE, N. Y.

[We add to Mr. Dewey's communication one of the drawings of the patent referred to by him, and illustrating his method of metal working.—EDS. E. W.]

The "Electric Limited."

The handsome vestibule train that will carry the Eastern delegates to the meeting of the National Electric Light Association at Kansas City will consist, on leaving Jersey City, of the composite baggage and smoking car "Raliegh," the dining car "Windsor" and the sleepers "Japan," "Scotland" and "Belgium," and the composite ladies' observation sleeping car "Olympic." At Chicago the sleeping cars "Phocian" and "Ilion" will be added to accommodate delegates who may join at that, or intermediate, points.

All the cars have just left the shops and contain every modern improvement that will add to the convenience or the comfort of the tourist, from a barber shop and bathroom to a stenographer and typewriter. The "Olympic' and the "Raleigh" are finished in dark mahogany with curtains and upholstering to harmonize. The other cars are finished in light mahogany with blue plush trimmings, except the "Japan," which has figured plush trimmings. The cars are warmed by the Sewell method of heating salt water in a coil within a steam drum and causing the same to circulate through the necessary pipes.

For lighting the train the Bauer system of electric lighting is used, the necessary current being secured from an Eickemeyer dynamo, giving 80 volts and 80 amperes at 900 revolutions, and driven by a direct connected Brotherhood engine running on 60 pounds of steam. The accumulators are placed on crates in boxes that are suspended in a cradle from the centre of each side of each car, immediately over the truss rods. Thirty-two cells, in two sets of 16 each, are alloted to each car, making a total of 256 cells, part being of the 23 M. type made by the Electrical Accumulator Company and part of the Julien make.

A total of 208 16-c. p., 60 volt, 42 watt, incandescent lamps are distributed through the train in sets of 26 to each car, plus the number of portable lamps, which will swell the total number to 260. The amps in the dining car are all placed on one circuit, as, generally, when one lamp is needed, all are required.

In all the other cars are two circuits, one called the centre circuit, carrying all the lamps opposite each section, and the other supplying current to the lamps in the vestibule, the drawing rooms and the toilet rooms. All the lights on the centre circuit are usually extinguished between 10 and 11 P. M., when the majority of passengers have retired, the remaining lights burning at longer intervals, except those in the vestibule and passageway, which burn all night. The wiring is all concealed in the moldings placed over the centre of the coach, except in the case of the portable lamps, where the wires are tapped on to the long circuit and carried in the panel behind the section mirror and terminate in two ½-inch tubes set in a round 1¼ inch block for the insertion of a plug. These portable lamps, having frosted bulbs, and sockets for inserting in the silvered thimbles placed in either corner of the section enable the occupant to read while reclining in his berth.

The Pullman Palace Car Company, who equipped this train, have adopted the Bauer system of electric lighting for all their special trains, owing to its features of cleanliness, comfort and safety, and above all because the appreciative traveling public demand it. And they propose to equip electrically every single coach as soon as a reliable system equal to the emergency is brought out.

Some idea of the thorough and careful manner in which this system of electric lighting has been carried out is shown in the fact that the electric equipment of this "Electric Limited" train cost the nice sum of $6,859.06, divided up as follows: Composite car, $,129.32, including dynamo and engine; dining car, $559.74; each sleeper, $695.00. The operating expenses, judging from past experience, will average 22-100 of a cent per mile or $1.14 per day, per car; or 4 5-12 cents per lamp per day.

Through passengers leaving New York in the morning are generally willing to retire early after the long ride, but on leaving Chicago at the close of what is generally a busy day, the reverse is the case, as is shown in the record of the lamp hours kept on the Pennsylvania Limited, the total difference approximating 178 lamp hours. This increase when going east in the winter months is shown by the following table copied from the December records:

A NEW INSULATING STAPLE.

Going East.

Time (Standard).	Hours.	Lamps.	Lamp hours.	Remarks:
4 to 9 P. M.	5	148	740	Chicago to Ft. Wayne, where one car is dropped.
9 to 11 P. M.	2	127	254	
11 P. M. to 1 A. M.	2	39	78	
1 to 6 A. M.	5	21	105	
4 to 7 P. M.	3	144	432	In to Jersey City.
	17	...	1,609	

Going West.

Time (Eastern).	Hours.	Lamps.	Lamp hours.	Remarks:
9:15 to 10:15 A. M.	1	144	144	In depot.
4 P. M. to 9:30 P. M.	5½	162	891	
9:30 to 11 P. M	1½	117	176	
11 P. M. to 1 A. M.	2	39	78	
1 A. M. to 6 P. M.	5	21	105	
6 to 7.30 A. M.	1½	21	37	
	16½	...	1,431	

Mr. A. H. Bauer, as chief electrician of the Pullman Palace Car Company, will have entire charge of this special train, and will accompany the delegates to Kansas City and return. The train will run over the line of the Pennsylvania Railroad from New York to Chicago, and thence, via the C. B. & Q. lines, to Kansas City,

The Work of Woodhouse & Rawson United Limited.

This company, as is well known, has taken over the business in England of Woodhouse & Rawson Limited, Woodhouse & Rawson Manufacturing Company, and Woodhouse & Rawson Supply Company, together with other business, at Manchester and Bradford, and has only been in existence six months, but its work during the past year may be spoken of for purposes of comparison, as if it had been in existence during the whole year. As regards its manufacturing business the extension has been steady and thoroughly satisfactory, Mr. Charles Baker, whose business was taken over by this company being in charge. The old specialties which are too well known for enumeration have been further improved, and the total number produced have been largely in advance of previous years, the turnout of one size of switch alone being over 1,500 per week.

In addition, several new specialties have been worked out and acquired, chief among these we may note the new insulating substance which is just being put upon the market, and which for all purposes to which slate has been hitherto used appears to have a most promising future. To this we may add Scott's electric flashing lantern for signaling purposes, which strikes out a totally new line and experiments upon which have been most successful on board one of Her Majesty's ships during the past four months. Scott's log appears to meet a great demand in a very simple manner. Other specialties are their new oil filter and sight feed lubricator. We hear also of very important improvements in incandescent lamps.

The company still continues to be a large manufacturer of automatic boxes of various kinds, both electrical and mechanical. In the supply department the extension of business has been remarkable, and recently important arrangements have been made for the supply of large quantities of goods to electrical companies abroad. Roughly speaking, the quantity of business done during the slack season has been well in advance of that done in the busy season the previous year. By the transfer of show rooms and warehouse to 30 Cannon street, the company has made an enormous improvement; and although it is not yet completely established in its new premises, little remains to be done. Business of all kinds will be greatly facilitated by the extended opportunities afforded to buyers of inspecting all classes of electrical goods.

In common with most electric firms, the contract department has been very busy; it has been principally engaged on electric lighting work, but transmission of power for farm and domestic purposes has also been carried out. Police alarm systems, bells, telephones and plating work have also added their quota to a year's industry. A noticeable and satisfactory feature has been the number of "repeat" orders from former clients. Among the more important may be mentioned (in house lighting) Lord Brassey, Sir F. Carden, S. Dickens, Esq.; in factories, etc.: Messrs. J. J. Murphey's brewery, Messrs. Findlater's, etc., etc. Among the most important contracts carried out are the Palace of the Maharajah of Mysore, Lord Ripon's house, etc. This department also does a considerable amount of maintenance work, such as that of Drapers' Hall, Exeter Asylum and various private places.

At the northern branch of the company's business, installations have been carried out at Messrs. Winterbottom's Victoria Mills, Weaste; Falcon Cliff Hotel, Douglas, Isle of Man; Messrs. Crook, Frank & Co., Hulme; Messrs. Dobson & Barlow, Bolton, and other important works.

Contracts for the supply of instruments have been filled with the London & Northwestern Railway, Caledonian Railway, Manchester Sheffield & Lincolnshire Railway, National Telephone Company, the Admiralty and other government departments. The engineering departments have been very busy, especially in the screw-making section, and a large amount of new plant has been laid down to enable the orders in hand to be executed.

By the acquisition of the Bradford business where installation work is very brisk (the company being specially appointed as contractors to the corporation), the sphere of the company's operations in this department has been considerably extended in the north of England. Among the installations carried out by this branch may be mentioned those at the Menston Asylum, with extensions of the same; Star Music Hall, W. Ackroyd & Co., Sir Titus Salt, Bart, Sims & Co., etc., etc. Electric light has been installed in a large number of buildings in connection with the Corporation Electricity Supply, and the only limit to extension of work in this direction is the want of power necessary for the increased number of lamps demanded by the public.

In the early part of the year the company identified themselves with the Elmore depositing process, full descriptions of which have appeared in our issues. Careful experiments were made by the company's electrician which more than fulfilled the expectation held out by the inventor.

An English company has been formed which is just now commencing work, and if we may judge from the market price of the shares which stand at over three times their face value, the undertaking is likely to be one of remarkable success. If it proves to be all that it claims, it cannot fail to be one of the most important commercial undertakings allied with electricity that has yet appeared. It is rumored that the application of the same process to another important metal is likely to appear very shortly, but of this we have no definite information.

By allying themselves with thoroughly sound and important inventions of this nature, the company has given electricity valuable assistance, and we have no doubt that with its new and powerful directorate, coupled with its excellent working staff, its progress in the future will be even more pronounced than in the past.

The company has declared a dividend at the rate of 8 per cent. per annum on the preference shares, and 15 per cent. on the ordinary shares.

The Missouri & Kansas Telephone Company.

Visitors to Kansas City during this week will have an opportunity of inspecting and proving to their own satisfaction how valuable long-distance telephony is where the circuits have been properly constructed, as Superintendent C. W. McDaniels has his lines in excellent condition, and a subscriber in Kansas City can now talk to a person at Sedalia without the slightest difficulty; in fact, so clear will the answers come over this line that it will be difficult to believe that the distance is nearly 120 miles. Mr. McDaniels has secured this perfect service by using metallic circuits of No. 12 standard gauge hard drawn copper wire placed on pole lines, forty poles to the mile, built out on the high road, away from any possible sources of trouble that might arise or be caused through induction. The same care in keeping up the old grounded circuits has been observed, so that on a recent occasion it was an easy matter to converse directly with a friend 227 miles distant over a grounded circuit passing through eleven exchanges. The towns of Severance, Hiawatha and Horton, in Kansas, have recently been connected with the exchange at St. Joseph, Mo., by complete metallic circuits, making a total of over forty exchanges now in circuit. Mr. McDaniels expects to place the Beach-Cook switchboard and transfer system, illustrated in THE ELECTRICAL WORLD of Sept. 14, in the exchanges at Leavenworth and Wichita, Kan., believing it to be the simplest system for exchanges having less than 1,200 subscribers.

In referring to the average number of telephone calls per subscriber in the territory covered by the company, Mr. Day K. Smith, the general manager, shows some interesting figures, slight study of which clearly indicates how every increase in the number of subscribers adds to the value of the exchange to each individual subscriber, somewhat after the fashion of a great journal furnishing its readers with matter of greater value in proportion as its subscription list increases, so that all are directly benefited by every new name added to the list of subscribers for telephone or paper. Again, one can probably draw some idea from these figures whether a town is closely built up or is scattered over a large area, with factories far out in the suburbs, where telephone service is in constant demand as a valuable time-saver. This fact is practically shown in two cases: where a town is closely and compactly built about a public square it has a smaller number of subscribers than is shown in a town of less population but having its buildings scattered along both sides of a stream.

The average number of calls in the Kansas City exchange during the above test was 12.6 per subscriber, but on January 21 there were 33,350 telephone calls answered and the day following 33,625. The greatest number of calls answered in one day reached nearly 37,000. Mr. Smith used an automatic recorder in indicating the number of calls, and thus has an absolute record of each day or hour's work. This recorder is a simple clock movement having a pair of electro-magnets in circuit that cause the hands to move forward when closed, in a manner similar to that employed in the electric time service, the closing of the circuit being secured in answering the call through the bridging of a metal plate when the cord is drawn down, by a brass ferrule fastened to the cord. It is an actual fact that in one afternoon during the fall of 1888 the calls came in so rapidly that one operator answered 246 straight calls during 60 minutes—an average of over four per minute. A better example of the perfect service afforded could not be desired, and it all came about through the postponement at the last moment of the parade of the Priests of Pallas. The city fire department are notified through this exchange when their services are required and are out of the station and on the street within 18 seconds after the alarm reaches the central exchange.

F. DEL.

Investigating the Electrical Industry.

Mr. A. J. de Camp, of Philadelphia, who is so well known in connection with electric lighting interests, has issued an important circular to the electric light and power companies of the country, in which he says: "Advantage must be taken of a bill now before a Senate and House Committee to secure the necessary authority for making a complete investigation of the electrical industry for the present census.

"This investigation should include all necessary details pertaining to underground and aërial construction, underground and aërial currents, the character and voltage of all currents and their uses. Lamps in use (arc and incandescent) and how wired for residences, commercial and municipal service; motors in use for stationary service and motor cars; income and expenses, etc.

"An inquiry should also be instituted through sources independent of those interested in the industry, as to casualties resulting from the use of electric currents, both as to fire and to personal injuries. This investigation should be made in all cities of 10,000 population and over. The information should be obtained from underwriters, the records of fire departments, coroners' statistics, health boards or commissioners, or from whatever source of information that may exist in any city. The investigation should also make a comparative statement between the casualties resulting from electric currents, and the use of other agents employed for similar purposes.

"In view of the present condition of public opinion and information the value of such an investigation will be enormous."

The companies are urged to sign a petition of the above tenor, asking for a special appropriation of $50,000 to the Census Bureau for the work.

An Open Letter to Mr. G. W. Curtis.

In a recent editorial we took occasion to call attention to the article by Mr. G. W. Curtis in *Harper's Magazine* for February, in which certain unfair and unfounded statements were made regarding electricity. Mr. Frank R. Upton, the well-known general manager of the Edison Lamp Company, has now addressed the following open letter to Mr Curtis on the subject:

Feb. 4, 1890.

George William Curtis, Esq, "Harper's Magazine," New York.

DEAR SIR: On page 447 of the February number of *Harper's Magazine* is the following:

"It is shrewdly suspected that the fire at the Brooklyn Tabernacle was kindled by them (the wretched wires), and not as was suggested, by the fervor of the pastor's eloquence."

The attached documents are forwarded to you to show that the Tabernacle fire was not caused by electricity. The General Manager of the Brooklyn Edison Company (See "A") states that the current was completely turned off at the switchboard on Saturday night by his own men, and that there was no current on the light wires in the body of the house during the night. After the fire the fact that the switchboard and meter were untouched, and before the fire, that there was no evidence of crosses occurring on any of the wires, is fully discussed by the manager, and seems conclusive evidence that there was no trouble in the Tabernacle from electric wires.

The committee of the New York Board of Fire Underwriters in its report to the Board (see "B") state that:

"There was not the slightest evidence to show that the fire was caused by the electric light equipment."

This is further corroborated by the report of Halsy & Pitcher (see "C"), of the Liverpool, London & Globe Insurance Co., who were adjusters for the company, and concluded their report by saying:

"We feel that in this case the electric light conductors are not responsible for the fire, nor did they aid it."

This report gives the probable cause as follows:

"It is just as fair to assume the fire to have started from careless tuners or defective flues as to attribute it to lightning. It appears that no one has been discovered who saw the lightning strike the church, nor was there any evidence of destruction by lightning; the theory finding its greatest support in the fact that a thunder storm raged at the time the fire started."

Mr. F. E. Jackson, who has investigated this matter for me, reports (see "D") that the new Tabernacle will be lighted in the same way as the old one—namely, electric light.

Generally, fire destroys all the evidence of its cause. In this case, very fortunately, the evidence that the fire was not caused by electric light remains, while the evidence as to what caused it experts were not able to obtain.

When people are talking of any epidemic of sickness every ailment is considered to be part of the prevailing sickness; so with the blame placed upon the electric light. To-day, for selfish reasons, electric light is being advertised as dangerous, the result being that many people consider electric light should receive credit for being the cause of all unknown fires when electric wires are present in a building.

All artificial lighting is more or less dangerous. The relative danger should be best known by insurance companies whose business it is to investigate such matters. Report "E" gives the various views of the New England Insurance Exchange, one of the ablest insurance bodies in the country, in which the conclusion is reached—

"That the system" (of lighting by electricity), "properly guided by a knowledge of electrical laws, and guarded by the various well-known automatic safety devices and current regulators, stands pre-eminently as the safest method of artificial lighting in vogue."

Under date of April 2, 1888, reduction in tariff rates in New England are made under certain conditions when electric lights are used.

On Jan. 4, 1890, the statement is made by Mr. S. E. Barton, Chairman of the Committee on Electric Light of the New England Insurance Exchange, after many years' experience:

"I am of the firm opinion that we could secure profit to our companies if we were to extend the granting of rebates for the exclusive use of incandescent lights to all classes of so-called 'mercantile,' or store risks, and thereby banish the gas jets, which ignite goods in show windows, and the kerosene lamps which explode in cellars."

Mr. Barton is a well known authority on insurance matters.

The question of danger to life which you mention later on page 478 should be qualified by the statement that there is no danger to life in cases where low-tension currents are used.

I think, if you will read carefully the documents submitted to you, and if not satisfied, either investigate yourself or empower some impartial man to investigate for you, the dangers of electric lighting, you will reach the conclusion that you have fallen victim to the designs of selfish men, in lending your powerful aid to the outcry against electric lighting. Yours truly,

FRANCIS R. UPTON.

This letter is accompanied by the documents severally referred to.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Feb. 8, 1890.

C. McIntire & Co., 13 to 15 Franklin street, Newark, report themselves as extremely busy. Their recent orders in "double terminals," which is something new—also connectors for trolley wire, hard drawn copper, another new line, are very large. They have large orders also for lamp and cut-out terminals of the McIntire patent for Canada; and for large quantities of connectors for copper, iron and a combination of iron and copper in large quantities.

Laird Bros., Steamship Builders, Birkenhead, England, and the Fairfield Ship Building and Construction Co., Glasgow, have recently ordered recording pressure gauges for the new ships for the trans-Atlantic trade they are building. The "City of Paris" and "City of Berlin" have also recently been equipped with them and Mr. Jarvis B. Edson, of 87 Liberty street, New York, reports many recent sales to electric light companies and others throughout the United States and Canada, 75 having been supplied to date to the Standard Oil Company.

The American Giant Dynamo Electro-Plating Machine made by the noted firm of Zucker-Levett Chemical Company, salesrooms and offices 40 Murray street, deserves mention, and I desire to say that thousands of platers and metal specialty makers consider it has no superior for doing successful work in the deposition of metals. It is made compact, strong, durable and convenient, and will run a bath for the work of a large factory. I know of one instance where it is doing all the plating for one of the largest factories for making gas fixtures in this city.

Waite & Bartlett, 143 East Twenty-third street, New York City, are pushing their storage batteries, which they brought out about seven or eight months ago. The special features are their capacity, which is claimed to be much greater than any other in the market, and a novel rheostat by means of which the currents are so regulated that physicians and surgeons may be able to use the same battery for delicate as well as for large instruments without burning or destroying the instruments. They can be charged from bluestone or gravity batteries or on any electric light circuit.

W. H. Ostrander & Co., 21, 23 and 25 Ann street, New York, the oldest makers of oral, electrical, mechanical and pneumatic anunciators, burglar alarms, bells, push buttons, speaking tubes, whistles and elbows, have been producing, since the addition of their electrical department some years ago, lines of goods that have gradually come into widespread use and which have grown so much in favor as to demand more facilities at the factory in Brooklyn. They have just put in a new 40-h. p. engine and boiler. They turn out millions of feet of tin tubing every year. Speaking of his electric bells, Mr. Peck says they use only platinum on all contact points, especially on the vibrator, and he claims superiority also in mechanical construction.

A. Livingston Bogart, 22 Union Square, exhibited to me this week a model system of electric railway, motor car all complete, for lecturing purposes, for a party in the west. The system is the work of the above gentleman. The car and model is two feet long, in exact proportion to the ordinary street car. The track is 35 feet, in 5 feet sections, to pack for shipping. The car motor is so set up that it automatically reverses itself at each end of the track. The motor is geared up to run, proportionately, at nine miles per hour. One cell of storage battery runs the model system, but two cells of Samson battery will also run the car. The motor is geared up to run at a maximum rate of speed with two volts and two ampères.

The Royal Electrical Specialty Company, 239 Water street, this city, are now pushing actively the Young safety cut-out recently illustrated and described in THE ELECTRICAL WORLD. They will have an exhibit, No. 34, at the Kansas City convention, and will be glad to send to any station one of their cut-outs on trial. This appliance is intended for use on all high-tension electric circuits, to insure safety against accidents. It operates automatically to render the wires dead instantly on breaking of circuit. It is attached to the dynamo or circuit, and operates so quickly and efficiently that an accident by the breaking of a high-tension circuit wire is impossible. The device is simple and compact, and cannot get out of order. The great advantages and protection afforded by this simple device are bound to secure its adoption by electric light and motor companies, and other users of electric machinery, wherever the apparatus has once been tried, and the Royal Company are thoroughly convinced of its efficient and satisfactory operation.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Feb. 5, 1890.

Mr. L. A. Milbank has resigned his position as manager of the Standard Electric Company of Vermont.

The Wainwright Manufacturing Company, of Massachusetts, have sold a 500 h. p. heater to the Norwich Electric Light Company, Norwich, Conn.

Westinghouse Electric Compay advise me that their head office is in receipt of an order from London for an increase of plant amounting to 15,000 lights. This will include dynamos, converters, and all necessary apparatus.

The New Steamer "Henry M. Whitney," of the Metropolitan line, is to be equipped with the Thomson-Houston system of electric lighting, and a special automatic engine of the McIntosh & Seymour type has been ordered in connection with the installation.

The Electric Gas Lighting Company, 56 Arch street, Boston, Mass., has issued "List G," which is a remarkably full and useful catalogue and price list of electrical goods and electric gas-lighting apparatus. It is replete with information, and contains a number of useful instructions.

The West End Street Railway Company are considering the question of marking the streets outside of the busy streets of the city where the electric cars will stop to take on and let off passengers. As soon as it has been determined which are the most convenient locations these places will be plainly marked.

Delegates to the Convention.—The following gentlemen from Boston and New England have signified their intention of attending the convention of the National Electric Light Association at Kansas City: Messrs. S. E. Barton, Captain Brophy, Colonel Ransom, Dr. Mason, of Boston, M. J. Francisco, Rutland, Vt., and M. J. Perry, of Providence.

Elevated Railroad Petitions.—Two more petitions are before the Massachusetts legislature for permission to erect and operate electric elevated railroads in Boston; one from Mr. Bartholomew, of the Riley Elevated Railway Company, and the other from Mr. R. T. White, who represents a system of his own. They have been referred to the committee on street railways.

Mr. George T. Manson and **Mr. Henry D. Stanley** have again favored their Boston friends with a visit. Mr. Manson's friends are all anxious to know if he is going out in charge of the special Okonite express train to Kansas City, so ably pictured in the advertising columns of the electrical press, or if he will favor the rest of the delegates with his presence in the regular convention train.

Dover, N. H.—The Consolidated Electric Light & Power Company, chartered in the Maine and New Hampshire legislatures, has consolidated the electric light plants of the Dover, Great Falls and Rochester Electric Lighting companies, with headquarters in this city, and power plant at the new dam, a mile below Great Falls on the Maine side of the river. Dover, Sawyers, South Berwick, Salmon Falls, North Berwick, Rochester, Great Falls, Berwick, Gonic and East Rochester are lighted by this system.

Thomson-Houston Electric Company—Railway Department.—So great has been the success of the electric railway in Minneapolis, even in the midst of heavy snows, that the local street railway companies in that city have abandoned the idea of cable railroads, even at a large pecuniary sacrifice, owing to part of the contract having already been filled, and have determined to adopt the electric system of the Thomson-Houston Company. Orders have been received for some 250 motors, and part of these motors will be put on electric locomotives. The business in Minne-

apolis will probably amount to $2,000,000 in the next two or three years.

Haverhill, Mass.—Mr. L. H. Rodgers, agent for the Brush Electric Company, has just closed a contract with the Haverhill Electric Light Company for one Brush arc light dynamo, with a capacity of 50 lights and 50 arc lamps of 2,000 c. p., and one Brush arc light dynamo of 45-light capacity, with 45 lights of 1,200 c. p. The contract includes all station apparatus necessary for the two dynamos. The Haverhill Electric Light Company have been intending to increase their arc plant for some time, and these dynamos will be placed in the new station. The 1,000-light Brush alternator recently sold to this company by Mr. Rodgers is now all set, and will be run in a few days, and many intending purchasers are eagerly awaiting the opportunity of witnessing its performance.

Boston's Electric Lights.—There is no subject in Boston which is attracting so much attention as the hearing before the Board of Aldermen to decide as to which company will have the rights to the public lighting of the streets of Boston. A hearing was had on the subject this week, when a number of witnesses and counsel appeared. Among the experts were Prof. Morton and Mr. E. H. Johnson. The hearing was continued and closed Wednesday, Mr. John C. Paige, for the insurance agents, and Mr. Howes, of the Boston Board of Underwriters, being examined. Mr. Burdett and ex-Governor Gaston then summed up, and the Aldermen then took up the matter in committee, and an early decision is expected. The Boston Electric Light Company has made a grand fight for its business, in response to the vigorous onslaught of the Suburban Company.

The John P. Cushing Company are just completing a very interesting and novel improved electric stable call, to be used in connection with the police patrol wagon system. The device is the invention of the fertile brain of Police Electrician, Henry A. Chase, the inventor of the marine electric recording compass recently described in the columns of THE ELECTRICAL WORLD. The device consists of a special transmitting movement which is capable of transmitting to the stable from the police station the number of the call instantly. There is a set of detachable plugs, with numbers corresponding to the numbers of the various call-boxes printed on the top. On the periphery of these plugs are cut teeth to form the electric signals corresponding to each plug's number. As soon as a call comes in to the station, the proper plug is inserted in the transmitter, a key is depressed, and the gong in the stable instantly repeats the alarm. In the stable is an electric gong wired in parallel with a Greeley register, mounted on a neat board. This board is also fitted with a telephone, and with push button and bell for telephone. The device is a great improvement over the old method, and renders mistakes impossible, and is an excellent testimony to the inventive genius of Mr. Chase and the skilful work of the Cushing Co.

Boston Electric Club.—At the regular monthly meeting of the Boston Electric Club, held this week, President Cram announced that he had received an invitation to the banquet of the New England Association of Gas Engineers, to be given on Feb. 19, at Young's Hotel, Boston, on the occasion of their annual conference to be held at Young's on Feb. 19, 20, 21, and also announced that an invitation had been extended to the members of the Electric Club, to be present at that conference. A vote was unanimously passed accepting the invitation of the Gas Association, and a committee consisting of Messrs. Stiles, Brophy and Wright, was delegated to attend the meeting and all other members were urged to attend if possible. A committee was also appointed to watch any legislative action with regard to electric affairs, and to report to the club if necessary at a specially called meeting. The Boston Electric Club is now entering upon a term of undoubted prosperity, and members are confident that by the end of the year all debt will be permanently removed. New applicants for membership are applying daily. The House and Entertainment Committee has issued to the members a very neat and useful card giving the dates of the regular meetings and dinners and the proposed papers to be read at these meetings, and I would call attention of members to the next important event, the club dinner to be held at Young's Hotel, Boston on Feb. 17, at 7.45 P. M., at which Mr. Arthur Lord will read a paper on "Legislation Relating to the Transmission of Intelligence, Light and Power by Electricity." A most interesting paper is expected from Mr. Lord, who is admirably equipped for the subject. An opportunity will present itself for discussion on Monday evening, Feb. 24. Mr. W. E. Coakley, of the Boston *Herald*, has written in the Sunday *Herald* of this week, an admirable article, describing the rooms of the club and the object of its existence, which goes to show the Boston Electric Club is now rapidly being recognized by the public and the press as one of the important institutions of the city. Mr. Coakley's kindly expressed wishes have been widely read and appreciated by the electrical fraternity, and it is gratifying to know that the daily press are rapidly becoming enthusiastic supporters of electricians who are endeavoring by every manner possible to imbue the public with a sense of their untiring efforts to give them a reliable and safe system of electric light and power. The members of the press are always welcome at the rooms of the club, and it is hoped that the relations between the press and club members will continue to grow more cordial day by day, as they recognize more fully the merits of the institution.

A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, Jan. 31, 1890.

Morris Tasker & Co., of this city, manufacture wrought-iron electric light poles of artistic design, and iron pipe and fittings for mast arms.

The Aurora Electric Company, Nos. 2218 and 2220 Emerald street, this city, are finding a ready sale for their small dynamo machines of five lights and upward.

Electric Lights for Vineland, Pa.—Advices from the above-named town say: "An electric light company is about being organized here. It is proposed to utilize a water power in the vicinity."

Kennett Square, Pa. A small borough near Wilmington wants its streets and stores illuminated by electric lights. A majority of the citizens favor electricity in preference to the naphtha illuminant now in use.

Weston Electric Motor.—At the branch offices of the United States Electric Lighting Company, in the Girard Building, this city, Manager Charles A. Bragg has a handsome little motor of the new Weston type on exhibition.

Media, Pa.—The Media Electric Light Company is running its wires to and through the neighboring boroughs of Moylan and Wallingford. The company has a contract in hand to fit up the Central Division Railroad station at Media with arc and incandescent lights.

Proposed Electric Railway.—A number of capitalists in Williamsport, Pa., are about to form a passenger railway company. They propose starting operations in the spring, and will have their cars propelled by electricity. The tracks will be laid from the Market street station of the Pennsylvania Railroad to the Demarest Works, and probably as far as Newberry.

The Heisler Electric Light Company's eastern headquarters are in the Drexel Building, this city, with General Manager Walter F. Smith, formerly with the Brush Electric Company in Chicago, in charge. During the past month Manager Smith has been very busy, as the Heisler Company's Eastern business is rapidly progressing. Mr. G. M. Rushing, of the company's New York office, was in Philadelphia last Wednesday.

The Wilkesbarre & West Side Electric Railway, of Wilkesbarre, Pa., has been giving thorough satisfaction to the citizens of that town since the day it introduced its electric cars. It is about three weeks since this mode of travel was first presented to the people of Wilkesbarre. The Sprague overhead system is used. Mr. C. R. Eberle, superintendent of the above-named railway, was in Philadelphia last Wednesday. He reports his road as being already on a good paying basis.

Mr. Chas. A. Bragg, Manager Philadelphia office of the Westinghouse Electric Company, the United States Electric Lighting Company and Sawyer-Man Company, very kindly informs me that inquiries for isolated work continue on the increase, while the demand for central stations is such as to keep his entire office force very busy. The following isolated plants—United States Electric Lighting Company's system—were installed by Mr. Bragg during this month: The Forest Springs Hotel, Brown's Mills, N. J., 500 lights; The United Electric Improvement Company, three 300-light plants; the Johnson Forge Company, Wilmington, Del., 10-light arc plant; J. H. Dialogue's ship yard, Camden, N. J., 200-light plant.

Queen & Co.'s Factory.—I had the pleasure, a few days since, of going through the large and well equipped factory of Messrs. Queen & Co., of Philadelphia, who are so well known throughout the electrical community as manufacturers of standard test instruments. Their factory is located in the very heart of the city and comprises one large floor, on which are 65 lathes, besides milling machines, engine drills, and a great many other pieces of special machinery. Their superintendent, W. C. Munson, is a man thoroughly familiar with his business, one who has been engaged in the construction of fine mechanism for many years. This factory now employs 67 workmen gathered from all parts of the country and from the famous shops of England and the Continent. It is probably the largest collection of skilled workmen, for this class of work, in America. I saw a number of their standard electrical instruments in the process of construction. Their standard resistance boxes are made in large lots and by the same workmen; this is also true of their standard galvanometers. This firm expect during the coming year to still more largely increase their facilities and to do contract electrical work for outside parties as well as to further develop their own business. They have just secured another building next their present factory in which will be located their forge, foundry and pattern rooms.

Two Isolated Plants for Cuba.—M. R. Muckle, Jr. & Co., of this city, the well-known electrical engineers, have received an order for the requisite equipment for two isolated electric light plants of three hundred 16 c. p. incandescent lights each. This order comes from a wealthy sugar planter in the interior of Cuba. The engines and dynamos will be packed and shipped intact (ready for placing on their respective foundations) to their destination. The peculiar yet interesting features of these plants are as follows: The dimensions of the building and the diagram of the adjacent plantation, including every detail connected with each—have been furnished Messrs. Muckle, Jr. & Co., by the purchaser. The wiring and construction work, including the wiring of sockets and cut-outs, will be set up in Philadelphia; then everything will be taken to pieces, each part being carefully marked and packed for shipment. On arrival at the plantation the purchaser and natives put up the machinery and apparatus in position, string the wires and make all the necessary connections, having as their only guide the printed and written directions (in Spanish) furnished by Messrs. Muckle, Jr. & Co. One plant will be used to light up the purchaser's large manor-house and surrounding grounds; the other will operate field lights of 50 to 150 c. p. on the sugar cane fields (belonging to the same person) to enable work to be carried on by night as well as by day.

PHILADELPHIA, Feb. 7, 1890.

Col. John T. North, of England, has embarked in an electrical enterprise recently inaugurated in London, and will henceforth devote considerable time and attention to the development and promotion of the new and important work he has undertaken.

Lecture on Electrics.—At the Franklin Institute, Monday, Feb. 3, Dr. Louis Duncan, of Johns Hopkins University, Baltimore, delivered an interesting and instructive lecture. Subject: "Modern Conceptions of Electricity." He illustrated his remarks with a stereopticon and electrical apparatus.

An Electric Club for Philadelphia?—A lively interest in this matter has been awakened in electrical circles here. The question is now being agitated among the Philadelphia electrical interests as to the advisability of the inauguration of an Electric Club, with aims, objects and purposes the same as similar organizations in Boston, New York and Chicago.

Mr. James Tatham, of the old established lead manufacturing house of Tatham & Bros., Philadelphia and New York, sailed for Europe on the Cunard steamer "Bothnia," Saturday, Feb. 1, and will remain abroad several months. Mr. Tatham is the inventor of the novel and meritorious wire conduit alluded to on page 65 of THE ELECTRICAL WORLD, issue of Jan. 25.

George W. Lord's Boiler Compound is now extensively used in electric light stations and plants throughout this country, and also in some parts of Canada and Europe. As a reliable and meritorious compound for removing scale from boilers, it has acquired a widespread popularity; and the claims made by Mr. Lord in his circulars have been substantiated by many well known engineers.

Marine Electric Plant.—The tugboat "International," the largest vessel of its kind in the world, owned by Messrs. Peter Wright & Sons, of this city, sailed from this port for the West Indies on Tuesday, Feb. 4. As previously stated by me the "International" is equipped with an electric light plant furnished by the Philadelphia office of the United States Electric Lighting Company. The plan comprises two "United States" dynamo machines of the largest type, which are interchangeable. The incandescent lights are of different grades ranging from 16 to 100 c. p. There are four arc lights of 2,000 c. p. each and one search light of 6,000 c. p. Any or all the lights can be thrown on either dynamo without shutting down.

A Mammoth Steam Engine.—Messrs. Robert Wetherill & Co., builders of the Corliss engine, pumping and cable machinery, Chester, Pa., have received an order to build the largest Corliss engine in the world. It is to be used in the Steel Works of Messrs. Carnegie, Phipps & Co., at Homestead, Pa. The cylinder will be 54 by 72 inches, and will weigh forty thousand pounds. The bed plate will weigh one hundred thousand pounds. The fly-wheel will be made in ten segments and will weigh two hundred thousand pounds. The crank-pin will be made of the best forged steel and will weigh seventeen hundred pounds. The shaft will be made of standard steel and will weigh forty thousand pounds. The casing will be of iron. The total weight of the engine will be something over five hundred thousand pounds, and it will furnish three thousand five hundred horse-power. It will be a horizontal engine. These large and powerful engines have been found a necessity in making steel plate, as it requires twice as much power as iron requires.

W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Feb. 7, 1890.

The Bijou Theatre, Pittsburgh, is displacing gas jets with incandescent lights.

The Joliet, Ill., Electric Street Railway will be opened for passenger traffic this week.

The Berkeley, Cal., Institute for the Deaf and Dumb has had an incandescent light plant installed.

Mr. C. J. Thomson, 100 East Fourth street, St. Paul, Minn., is agent for the Continental Dynamo Co. of this city.

Mr. David R. Chalmers, of the Empire City Electrical Company, New York, has been visiting friends in Chicago during the last few days.

Mr. B. M. Downs, of the W. M. Brookfield Company, New York, has been a welcome visitor here, and is quite an admirer of the Western metropolis.

Mr. L. B. Parker, general superintendent of the Postal Telegraph Company, is now in Denver arranging for the extension of the postal lines west from Hutchison, Ky.

The Thomson-Houston Company is working up business for a central incandescent station on the South Side, Chicago. The Edison Company of Chicago appears to be on the alert also.

The Franklin, Tenn., Electric Light and Power Company have just installed a 60 h. p. complete steam plant bought of Russell & Co., through their branch house at Atlanta, Ga.

Mr. Samuel E. Nutting, Chicago, will shortly bring out a device for automatically varying the speed of the armature without changing the speed of the pulley, the current remaining constant.

The Hazleton Tripod Boiler Company, Chicago, have received an order from Julius Marr, Frankfort-on-the main, Germany, who referred to their adverisement in THE ELECTRICAL WORLD.

The Knapp Electrical Works, Chicago, have received an unusually heavy consignment of duplex incandescent lamp cord, and customers can rest assured that their orders for same will be promptly filled.

Norfolk, Neb.—The board of directors of the Norfolk, Neb., Electric Light Company at their meeting to-day declared a semi-annual dividend of 6 per cent., 4 per cent, payable at once and 2 per cent. in ninety days.

The Grass Valley, Cal., Electric Light Company was compelled to shut down last week, owing to the lack of water supply to operate its turbines, caused by the unusually heavy fall of snow. All the telegraph wires were broken down by the weight of snow.

Mr. E. T. Turney, the assistant treasurer of the Auditorium, Chicago, is quite an enthusiast on the subject of electricity, and having made its practical application a study for several years, hopes soon to bring out a few devices of value in incandescent lighting.

Mr. H. C. Sprague, superintendent of telegraphs of the Kansas City, Fort Scott and Memphis railways, has constructed 250 miles of circuits and placed the apparatus in 26 stations for operating the Edison phonoplex system on their lines east of Memphis.

Detroit's Lighting Contract.—The attorneys in the electric light case went before Judge Hosmer Feb. 1, and practically agreed that the two suits should be declared off. Judge Hosmer further refused to entertain the contempt proceedings against the Board of Aldermen.

The Knapp Electrical Works, Chicago, have just made an extensive shipment of their specialties to Melbourne, Australia, which speaks volumes for their enterprise, as well as for the business prudence of the purchaser, who saw the advertisement in THE ELECTRICAL WORLD.

The Chicago Electric Club.—Despite the heavy rain storm some thirty-five members gathered in the club parlors on Monday evening, to listen to the reading of a paper on the operation of electric motors on high-tension currents of 3,000 volts or more, by Elmer A. Sperry.

Mr. Myron A. Knapp, Manager of the Knapp Electrical Works, Chicago, is going to the convention at Kansas City with his pockets filled with samples of Grimshaw wires and Perkins lamps, and a dozen other things. But, best of all, Myron is loaded down with new stories, and a better story-teller is seldom found. So try to secure a seat near him.

John J. Ryan & Co., Chicago, are making large quantities of connections, plunges, bases, and other brass castings for various electrical companies, and report business unusually good. They will probably have a handsome line of sample castings on exhibition at Kansas City during the convention.

The Wisconsin Telephone Company were refused their request for an injunction restraining the Eau Claire, Wis., Street Railway Company from operating the Sprague system of electric railways with a grounded circuit, Judge Bundy delivering the decision. The case will be appealed to the Supreme Court.

Brownlee & Company, Detroit, Mich., a new corporation to be known as Brownlee & Co., has been incorporated. It will continue the business of the late William G. Brownlee as general lumber and telegraph pole dealers, with a paid up capital of $75,000. The stockholders are Mary Brownlee, who holds 4,375 shares; John N. Brownlee, 1,875, and William E. Brownlee, 1,250.

Sacramento, Cal., is at last to have an electric light plant. For years the councils of that thriving town on the Pacific coast have been investigating into the different methods of electric lighting. They wanted the best and they debated long before making a decision. A contract for alternating current apparatus of 1,500 lights was given to the Westinghouse Electric Company.

Street Railway at Findlay, O., Sold.—The Lima Avenue and West Park Street Railway Line has been sold to George B. Kerper, of Cincinnati, president and principal stockholder of the Findlay Street Railway Company. The line is the pioneer one of the city and three miles in length. The price paid was $30,000. One

management now controls fifteen miles of road, all built within two years past.

Shay, Stephens & Company, Chicago, have just received a heavy consignment of glass pipes, having stems *six feet* in length, which they will present to the delegates en route to the convention, who may prefer a pipe to a good cigar. And the delegate who forgets to carry back to "the girl he left behind him" one of the eight-foot La Tosca glass canes will certainly deserve a drum-head court martial.

Corporations Cannot be Libeled.—Judge Tuthill, of Chicago, has decided that a foreign corporation cannot bring a suit for libel in this State, comity between commonwealths not being carried to that extent. It can sue in its own State. Also that it was not libelous to charge a corporation with piracy because a corporation could not actually pirate. Its officers might, and if they were libeled they could sue for damages.

The Mound City Messenger Company, of St. Louis and the St. Louis Express and Messenger Company have pooled their interests in the messenger business. The arrangement was consummated Feb. 1, and the linemen of the Mound City Company were busily engaged during the day rearranging the wires. The new arrangement is of great benefit to both companies, but especially beneficial to the Mound City Messenger Company, which has almost monopolized the cab business of the city, and is making great efforts to control the messenger and express business also.

The Sperry Electric Company, Chicago, have moved into their new and commodious quarters on Canal street, where they can take better care of the enormous business that has grown up practically within a year. Among their recent shipments have been a 30-light plant to the Edison Illuminating Company at Easton, Pa., a 20-light and a 6-light plant to Lattig & Jacoby, South Bethlehem, Pa.; a 30-light plant to Martinsburg, W. Va.; a 10-light plant to Atlantic City, Ia.; a 100-light plant to the Hyde Park Electric Light and Power Company, Chicago; a 12-light plant to Charles Karstiner & Co., Chicago; and a 60-light plant to Paterson, N. J.

Mr. L. W. Davis, Superintendent of the Queen City Electric Company, Cincinnati, has now increased the steam plant of his light and power station to 750 h. p., and is operating some 6,000 incandescent lights and a large number of motors. Mr. Davis has secured unusually good prices for all the current he can supply. In referring to the life of incandescent lamps, he stated that a carefully kept record had shown that the life of 16 c. p. lamps averaged 700 hours, while the lamps of greater range would often give good satisfaction after burning over 3,500 hours, and that 3,000 hours was probably the average life of a 75 to 150 c. p lamp.

Fraser & Chalmers, Chicago, manufacturers of mining machinery, have concluded arrangements with a syndicate of British capitalists by which they will build and operate an extensive plant in England. In addition to their mining machinery, the finest of American engines will be turned out. The advantage to be gained, they claim, is that from England freight can be carried to Africa and similar parts of the world quicker and cheaper than from this country. The present business will be continued here, but one of the partners must supervise the English works. The partners will relieve each other in this duty at intervals of a year.

Rapid Transit in Detroit.—The *Detroit Free Press* says: The managers of the street railways in this city will be pained to learn that the Buffalo Street Railroad Company has actually petitioned the Common Council of that city for leave to change its motive power from horses to electricity. Whether the friends of the petitioners have made any application to have their sanity inquired into does not appear; but the street railway people here would undoubtedly contract to furnish all the necessary testimony if such proceedings were taken. They have decided that the time has not yet come when rapid transit can be made to pay in a city like Detroit; and they would of course be willing to swear that it is madness to think of trying it in Buffalo.

Mr. W. S. Chapman, Secretary and Treasurer of the Central Union Telephone Company, Chicago, states that the year just past was the most prosperous in the history of the company; that a larger amount of construction and also reconstruction and improvement of the lines was completed last year than in any one previous year; and that the continual growth in the number of subscribers at all the stations indicates the high estimation in which the service is held by all prominent citizens. At the annual meeting, held last month, Col. R. C. Clowry was continued in office as vice-president and acting president, and the following board of directors was elected: George Albree, C. R. Cummings, R. C. Clowry, C. H. Brownell, F. H. Griggs, J. E. Hudson, J. R. Jones, M. G. Kellogg Robt. T. Lincoln, Norman Williams, J. F. Wallick.

Mr. F. S. Terry, manager of the Electrical Supply Company, Chicago, gave a dinner on Wednesday evening, Jan. 29, to the heads of the various departments in the company, at which occasion was taken by Mr. Terry to thank the gentlemen present for the exeellent work done during the past year, as evinced by the large increase of business, greater number of customers and the general satisfaction expressed by them with the manner in which their orders were handled and their wants anticipated. Various methods were then discussed by which customers' interests might be still further advanced during the present year, and it is said that the customers of the Electrical Supply Company will be directly benefited as a result of Wednesday's little dinner. The evening terminated with a vote of thanks to Manager Terry for his hospitality and kind expressions to those present. The following appropriate menu was thoroughly enjoyed:

Oysters on Half-shell—A la Shield brand. Soup—Aux glossy insulations. Whitefish—a la Ellis oil filter. Filet of Beef—Served with poles, cross-arms, pins and insulators. Potatoes—With bolts and washers. Cardinal Punch—Measured by No. 2,512 Standard testing set. Central Station Bird—Accompanied by Wirt standard voltmeter. Champagne—Moisture proof. Cake—Taken by our absent member. Cheese—With P. & B. compounds. Coffee—Weatherproof. Cigars—Fuse wire connections. Conversation—Continuous and alternating.

The Cincinnati Electric Light Company.—Superintendent George F. Card, in referring to the subject of supplying electric current for lighting and power purposes, said: We shall probably charge at the rate of four cents per lamp hour for arc lights of 2,000 candle power, and half a cent per lamp hour for incandescent lamps of 16 candle power. We are enabled to make these low rates owing to the perfect manner in which our station has been constructed, and the slight operating expenses we shall be under, as referred to in THE ELECTRICAL WORLD of August 24, 1889, and February 1, 1890. We shall simply sell current to any one desiring it, carrying our wires to the building, and, when incandescent lights are in use, allowing the party to have the wiring done by any firm or person, we merely testing the work before closing the circuit. In the same way we shall supply current for operating motors, through a meter, thus leaving all question of the efficiency of the machine to the consumer and the agent. By permitting and encouraging the use of any and every type of serviceable motor on our lines, we believe that many small power users will rent or purchase a motor who have not heretofore contemplated doing so. We shall adopt new methods never before tried in popularizing this branch of the industry. Within the station we have had our boilers placed on Jarvis settings, and shall use for fuel the lowest form of coke breeze, from which a greater amount of gaseous matter has already been extracted than is ordinarily secured. This fuel is raised from the ground floor to a point directly in front of the furnace-doors by hydraulic elevators. Our water costs merely the expense of pumping. The bottom plate of the tubular boilers is made without a seam, and we have a double line of steam piping running from all the boilers, so that any one boiler may be cut out and repaired without affecting the others. All the lines of shafting and clutch pulleys were installed by the Eclipse Wind Engine Company, of Beloit, Wis. Mr. Card is a firm believer in currents of high potential, and in large units, and knows of no reason why they cannot be successfully and economically operated where careful installation, perfect line construction and constant inspection is observed.

F. DE L.

KANSAS CITY, Mo., Feb. 6, 1890.

Mr. L. S. Jenkins is representing the Royal Electric Co. at Kansas City, having offices at 121 W. 6th St.

Mr. L. C. Bair, of Kansas City, proposes to open a well-equipped repair shop and model works in that city and to make a specialty of the rewinding of armatures.

The Western Electric Construction Company, 505 Delaware street, Kansas City, make a specialty of installing electric light and railway plants. Mr. M. E. Bates is the manager.

The Pond Engineering Company, of St. Louis, have a branch office in Room 31 in the Water Works building at Kansas City, and are fully equipped to take care of the largest installations.

W. T. Osborne & Co., 516 Rialto Building, are the local agents for the isolated work of the United Edison Company. They also represent the Eddy Electric Manufacturing Company, and do a general construction business.

Horace A. Keefer, with offices in the Gibraltar Building, Kansas City, is the local agent for the Excelsior electric dynamos and motors, the Peckham Street Car Wheel and Axle Company, the Phœnix and the Hamilton-Corliss Engines. Mr. Keefer carries constantly in stock a full assortment of street railway supplies, poles, etc.

W. T. Osborne & Co., Kansas City, Mo., wired the Coates Opera House for 500 incandescent lamps of 100 volts potential when the place was refurnished. They also wired the Merchants' National Bank and installed the Edwards call system therein; and installed the isolated plant of 270 lamps complete in the handsome residence of Col. W. R. Nelson, of the Kansas City *Star*.

The Dean Brothers' Steam Pump Works, of Indianapolis, Ind., can satisfactorily refer delegates to the convention at Kansas City to the following well-known firms in that city who are using their celebrated pumps: George Fowler & Son, pork packers; the Heim, the Burgweger and the Muehlebach breweries; the Kansas City and the Martin distilling companies; the Kansas City Cider Mills and the Monarch Vinegar Works.

The Gate City Electric Company, 522 Delaware street, Kansas City, is *the* supply house for the Missouri Valley and the vast territory tributary thereto, and within its warerooms are complete lines of all the appliances used in the various electrical industries. Mr. J. W. Mason, the general manager, has secured the agency for the Okonite wires, the Interior Electrical Conduit System, the Law battery and K. W. cut-outs and rosettes. Mr. Geo. W. Johnson is the assistant manager.

English, Morse & Co., 1221 and 1223 Union avenue, Kansas City, carry constantly in stock a complete line of steam and hydraulic machinery and all necessary engineering supplies. As agents for the following-named well-known companies, they have made some extensive installations in the West. They represent the American Leather Link Belt Company, Hill Clutch Works, Heine Safety Boiler Company, Henry R. Worthington, A. L. Ide & Son, Eclipse-Corliss Engine, and others.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Jan. 29, 1890.

The Proposed Association of Metropolitan Electric Lighting Companies.—A meeting was held last week at the offices of the Metropolitan Electric Supply Company, under the presidency of Sir John Pender, for the purpose of considering the formation of an association of the companies now supplying London with current under statutory powers. The idea of this association is, that it would not only enable the Metropolitan companies to take combined action whenever their common interests were threatened, but would probably secure a degree of uniformity in such matters as indoor wiring, lamp voltages, etc., which would otherwise be impracticable.

Bradford Lighting.—This town, as your readers will recollect, possesses a municipal central station on the low tension system, upon which something over £22,000 has already been spent. Although the station was only opened in September, the demand for current has been so great that the plant is now strained to its utmost capacity, and the Corporation has empowered the electric lighting committee to spend an additional £10,000 in enlarging the works. It does not seem, however, that the charge of five pence per Board of Trade unit is at present remunerative and an increase in the price is hinted at. It is to be hoped that this will be noted by many of our local authorities who intend to indulge in the luxury of municipal stations, and who in every case propose to charge ridiculously low prices for the current.

Lectures on the Electro-Magnet.—Prof. Silvanus Thompson is at present delivering an interesting series of cantor lectures at the Society of Arts on the "Electro-Magnet." The subject is being treated as one might expect it would be by Prof. Thompson. In the first lecture, which was chiefly historical, Prof. Thompson brought out with great emphasis the valuable discovery of the long-coil magnet by Prof. Henry, which alone made Morse instruments capable of working through long distances, and which was subsequently claimed by Wheatstone. In his lectures Prof. Thompson proposes to develop fully the principle of the magnetic circuit, the best way of designing magnets for special purposes, and the best way of combining different forms of magnets for special purposes.

Challenge to Electric Traction.—The Lea Bridge, Leyton and Walthamstow Tramway Company have made an announcement which is practically tantamount to a challenge to electric traction to come and do its worst on that company's lines. The company is about to invite tenders for the horsing of its cars for the next twelve months, but as it already possesses parliamentary powers to use electricity, it offers to guarantee a minimum mileage of 250,000 to 300,000 miles to any properly equipped electric traction company which is prepared to undertake the work at a reasonable price. It will be interesting to see whether this challenge will be taken up either by the Electric Construction Corporation, with its Sprague and Julien patents, or by the representatives of the Thomson-Houston system, or by the Electric Traction Company, whose Immisch motors have done so much good work.

The Lighting of Chelmsford.—As your readers will probably recollect, Mr. R. E. Crompton obtained, some little time ago, a lighting concession from the Chelmsford Town Council. Mr. Crompton proposes to use the alternate current transformer system, and he has run his wires on stout wooden poles along the streets, placing his transformers on the poles, after the manner so much in vogue with you. This introduction of American methods has given rise to considerable dissatisfaction among the good people of Chelmsford, the result being that the Board of Trade sent down their inspector, Major Cardew, R. E., to report as to the safety of this novel proceeding. I may remark, in this connection, that one of the many bad results arising out of the agitation on your side of the water has been, that our local authorities, who were never much in favor of overhead wires, now show an unreasoning antipathy to them. At Exeter, motions are constantly being brought forward in the Town Council to cancel the permission given to the lighting company there to employ overhead wires. At Dundee permission was refused the other day to erect a single overhead wire, carrying a 50-volt current, on the ground of the danger involved. At Glasgow it has been decided to petition the Board of Trade to put in force the section of the Electric Lighting Acts relating to companies employing overhead wires without having previously obtained statutory powers. At Weybridge, where permission has been granted to erect overhead wires, an agitation similar to that at Exeter has been got up. It will thus be seen that neither small towns nor big towns will have anything to do with overhead wires.

LONDON, Feb. 3, 1890.

Electric Light at the British Museum.—The installation at the British Museum, which comprises 137 arcs and 827 incandescents, was inaugurated on Tuesday evening. The installation is chiefly noteworthy for the extreme care taken to avoid any danger of fire or breakdown.

Telephone Extensions.—The trunk wire connecting the metropolis with the manufacturing towns in the North is now completed as far as Edgeware, nine miles from the city. The line has so far given very satisfactory results, communication via Birmingham having been established with Manchester, Bradford and Leeds.

Reduction in Telephone Charges.—The "co-operative telephone" movement has evidently had some effect upon the directors of the National Telephone Company, who now announce to their subscribers in the Liverpool and Manchester districts that the annual charge for telephones will be reduced, after April, from £20 to £15 per annum.

The Lighting of the City.—The electric lighting of the city has been advanced another step by the concession of the eastern division to the Laing, Wharton & Down Construction Syndicate, who use nothing but Thomson-Houston plant. The central division having been allotted to the Brush Company some six weeks ago, there only remains the western division, for which the London Electric Supply Corporation are in treaty.

Barnsley.—The Town Council of Barnsley and the local gas company have recently been indulging in a somewhat smart struggle with regard to the price of gas. A few days back the gas company gave notice of their intention to terminate the contract for public lighting at the end of June, and the reply of the Town Council has been to advertise for tenders for the public and private lighting of this busy manufacturing town. If this is to be the result of contentions between local authorities and gas companies, they will have the hearty support of electrical engineers.

Lighting at Brighton.—At a meeting of the Brighton Town Council last week it was decided to spend the sum of £30,000 upon a municipal central lighting station. The system to be employed is low tension, with storage batteries, and the price to be charged per unit is six pence. It is difficult to see how a profit of 20 per cent. hinted at by some of the speakers in the discussion which took place upon this question is to be made at Brighton out of six pence per unit, when at Bradford, where coal is probably 30 or 40 per cent. cheaper, five pence per unit is evidently found unremunerative. It is a weakness on the part of our municipal authorities to supply current at a price which, in many cases, can scarcely pay working expenses.

The London Subway Railway Schemes.—Of the five schemes for running subway railways, to be worked by electricity, under the streets of the metropolis, one only is to be proceeded with, namely, the Central London Railway scheme, which, as your readers, perhaps, recollect, is very well supported, and has for its engineers Sir James Fowler and Mr. Benjamin Baker. At a recent meeting of the City Tradesmen's Club some interesting figures were adduced with regard to the enormous increase of late years in the number of passengers carried by the various metropolitan companies. The tramways, the omnibuses, and the underground railway combined carried in 1864 53,000,000 passengers, while last year the same companies carried 330,000,000, or an increase in twenty-five years of 600 per cent., the population of the metropolis having during the same period increased only 40 per cent. It is evident, therefore, that the municipal rapid transit problem is in London of almost as great importance as in New York.

Dr. Joule's Discoveries.—The Friday evening lectures at the Royal Institution were appropriately opened last week by a most interesting account of the life and labors of the late Dr. Joule. The lecturer, Prof. Dewar, in the short space of an hour, contrived to give a fairly complete *résumé* of Joule's researches in the domain of electro-magnetism, electricity, chemistry and general physics. The manner in which the great *savant* ascertained the law connecting the electrical energy expended and the heat evolved in an electric circuit was clearly explained, and several of the experiments employed in the determination of the mechanical equivalent of heat, the maximum density of water, etc., etc., were neatly performed. Prof. Dewar terminated his discourse by quoting some reminiscences of Joule, supplied him by Sir Lyon Playfair, the great philosopher's friend and fellow-worker, and once again the story was told of Joule's failure to secure the chair of physical science at the University of St. Andrews and the rejection of his early papers by the Royal Society. As an illustration of the earnestness and singular simplicity of Joule's nature, Sir Lyon Playfair related how his friend one day proposed a visit to Niagara, not with a view of enjoying the scenery or of bewailing the powers there daily running to waste, but merely in order to determine the difference of the temperature of the water at the top and at the bottom of the falls. Throughout his lecture Professor Dewar laid great emphasis on the remarkable accuracy of Joule's results, an accuracy, indeed, which seems little short of miraculous to the latter-day scientist, provided as he is with every kind of elaborate apparatus. I may mention in this connection that the Royal Society has decided to make the proposed memorial to Doctor Joule international, and the present idea is that this memorial shall have for its main object the encouragement of physical re-

search. It is to be hoped that sufficient funds will be raised to enable a memorial worthy of the man to be erected.

The Discussion on Dr. Hopkinson's Presidential Address on Magnetism.—Dr. Hopkinson's inaugural address gave rise, as was to be anticipated, to a very interesting discussion. The debate was openec by Sir William Thomson, who thought that the president had laid too great an emphasis upon the magnetic isolation of iron, nickel and cobalt, for Faraday had shown the continuity between paramagnetic and diamagnetic bodies, and that all substances were susceptible to magnetism when subjected to sufficiently intense magnetizing forces. Sir William Thomson suggested that several physical properties of iron should be tested while it was kept at temperatures a little above and little below the critical one. Prof. Roberts-Austin, referring to the remark of the president that wrought iron in cooling does not evolve heat as carbonized irons do, reminded the Institution that pure electro-deposited iron on cooling down from 1,200 degrees C. *does* evolve heat suddenly when the temperature falls to 858 degrees C., a phenomenon which points to a molecular change in the iron wholly unconnected with the presence of carbon. As regards Dr. Hopkinson's statement that "the magnetic properties of iron appertained to the molecule and not to the atom of the mass," Prof. Austin asked whether it was a great step from this to admit that more than one kind of iron can exist. Normal iron may, he urged, under certain conditions, pass into an allotropic form in which the arrangement of the atoms in the molecule is different from that in ordinary iron, and the physical properties of these two kinds of iron are as totally distinct as those of the allotropic modifications of sulphur and phosphorus are from those of the elements in their normal forms. Prof. Ayrton, speaking of the magnetic properties of iron at high temperatures, inquired if Dr. Hopkinson had tried whether these properties were regained at a white heat. He himself had tried a few experiments in this direction, but so far without positive result. Another question on which he required further information was an apparent anomaly in the magnetization of the iron rings which he had constructed some years ago from the same bar and annealed together. One ring was continuous, while the other was divided by a narrow slit. On determining their magnetization curves the induction in the divided ring was found to be considerably below that in the whole one for low values of the magnetizing force, but for large forces induction in the cut ring was decidedly greater than in the uncut one. Mr. Preece, referring to the magnets used by the Post Office, said that the quality of magnet steel had seriously deteriorated. In 1883 steel, giving a permanent induction of over 5,000 c. g. s. units, was obtainable; in 1886 this maximum had fallen to 3,500, and recent tests showed a still further deterioration. This subject, he thought, required the serious attention of our manufacturers. Mr. Preece's remarks on the deterioration in the quality of magnet steel were confirmed by Mr. Sydney Evershed. The President, in replying to the remarks of the various speakers, said, that although he had heated the iron up to 950 degrees C., he had found no return of the magnetic qualities suggested by Professor Ayrton. The president could offer no explanation of the anomaly alluded to by Professer Ayrton. In conclusion, Dr. Hopkinson gave some additional information with regard to the variation of the specific resistance of nickel-steel with the temperature, and found that a considerable reduction was produced by cooling it in solid carbonic acid.

THE TELEGRAPH.

The Writing Telegraph Company has been incorporated at Baltimore, Md, to operate in Maryland. The capital stock is $100,000. E. F. Abell, B. F. Deford, M. Jenkins and others are in corporators.

The Canadian Telegraph Suit Dismissed.—At Montreal, on Jan. 31, Judge Wurtele dismissed the great telegraph suit on the ground that the Canadian Pacific Railway should have been first sued for trespass, and that the Montreal Telegraph Company might have been called upon to protect the Great Northwestern Company in that proceeding. Each company pays its own costs. The judge did not express an opinion as to the merits of the case, whether the agreement was a lease or not, or whether the Great Northwestern Company was entitled to two or three per cent. reduction. Large stock transac'ions have occurred pending the decision, which really settles nothing. The case will be appealed by the Great Northwestern Company, which, in view of the judgment, will cease paying rental till the queston is decided on appeal.

THE ELECTRIC LIGHT.

Bridgeport, W. Va., proposes to have a plant.

Rogers, Ark.—Mr. J. W. Scraggs wants estimates on a small plant.

Suffolk, Va.—W. N. Camp will put in a plant under his franchise.

Russellville, Ala.—A. Parrish has bought a plant for his iron mines.

Summit, Miss., with McComb City and Magnolia, proposes to have a plant.

The Haverhill (Mass.) Electric Light Company has just installed a 125 h. p. Ball engine, sold them by C. R. Vincent & Co, 15 Cortlandt street, New York City, agents of the Ball Engine Company.

Elmira, N. Y., received another boom in electricity a few days ago when the Westinghouse alternating plant there was increased to the extent of a new 750-light machine. This gives the plant a total capacity of 1,500 lights.

The Westinghouse Electric Company received orders for arc lighting apparatus from the following places during January: Allegheny County Light Company, Pittsburgh, Pa., 125; Salem, O., 20; Oldtown, Me., 35; Uxbridge, Mass., 20; Boston, Mass., 653; New York, N. Y., 125.

The Metropolitan Electric Supply Company, Limited, of London, England, is about to add a large increase to its electric light plant in the English metropolis. The Westinghouse Electric Company was awarded a contract recently for alternating current apparatus of a capacity of 15,000 lights.

Westinghouse Central Stations.—During the month of January central station plants in the following places adopted the Westinghouse alternating current system of incandescent lighting; Jacksonville, Ill., 750; Gouverneur, N. Y., 750; Sacramento, Cal., 1,500; Hampton, Va., 750; Allentown, Pa., 1,500.

The Westinghouse Electric Company obtained the following orders during January for central station plants, alternating current apparatus: Jacksonville, Ill., 750; Allentown, Pa., 1,500; Elmira, N. Y., 750; Red Oak, Ia., 750; Gouverneur, N. Y., 750; Uxbridge, Mass., 750; London, Eng., 15,000; Sacramento, Cal., 1,500; Hampton, Va., 750.

Miss Garrett's Mansion, Baltimore.—Referring to the item that we published last week, in regard to the superb electric lighting effects obtained, especially in the picture gallery, Mr. A. L. Bogart, of 22 Union square, writes us that the fixtures were specially designed for him for the work, and that he carried out the installation.

A Good Move.—At a meeting of the Southern Tariff Association, held at Atlanta, Ga., on Feb. 1, the secretary was instructed to report to the different companies all failures on the part of property owners to correct deficiencies in the insulation of wires recommended by the expert electrician of the association. Policies will be withdrawn from electric light companies and property owners who refuse to make these corrections.

Easton, Pa.—The Edison Electric Illuminating Company, of Easton, Pa., has just declared a five per cent. dividend on its stock. It started just one year ago with 800 lights connected up to its mains, and although no fewer than 4,000 lights are now connected, the orders for lamps still come in. During the month of November the capacity of the station was doubled, and the company now have 500 h. p. in a building that measures 30 × 90 feet. H. G. Tombler is president; J. T. Knight, vice-president, and Howard Rinek, general manager.

The Pennsylvania Railroad Company's Fourth street offices, Philadelphia, are installing an electric light plant consisting of a Watts-Campbell 125 h. p. Corliss engine; two United State dynamos, 600 lights capacity each, with handsome switchboard put up in the usual first-class manner that the United States Electric Lighting Company perform their work. This plant will have a capacity of 1,200 lights, and is so arranged that there will be light in the building at all hours. Mr. C. A. Bragg, the local Westing house representative, has the matter in charge.

The Northwest Electrical Construction and Supply Company, of St. Paul, Minn., secured a franchise for equipping and running an electric light plant in the city of Mitchell, S. D., and they have put in a first-class plant, as the people of Mitchell will testify. The plant consists of a Thomson-Houston 1,200 c. p. K² dynamo, and one 600 16 c. p. alternating current dynamo; and the power is furnished by an 80 h. p. Rice automatic engine, which for steadiness cannot be excelled. The Northwest Electrical Construction and Supply Company sent out their expert electrician, Mr. E. L. Castle, to start up the plant and run it awhile for the company.

APPLICATIONS OF POWER.

Fort Worth, Tex.—The Fort Worth Street Railway Company has contracted for 15 Thomson-Houston cars.

The Marvin Electric Drill Company has been formed at Syracuse, N. Y., with a capital stock of $300,000.

The Omaha Street Railway have ordered fifteen more electric motor cars, in anticipation of the spring business.

Springfield, Ill.—The City Council has passed an ordinance permitting the two street railway systems to change their motive power from horses to electricity.

Dallas, Tex.—The Dallas Rapid Transit Railway Company has applied for permission to construct a double track railroad to be operated by cable, electric or horse power.

Hallowell, Me.—The Thomson-Houston road of the Augusta & Gardiner Electric Railway Company, to run between Augusta and Hallowell, is to be ready by the end of June. It will be three miles long, and will begin with three motor cars and three trailers.

Frankfort, Ky.—A bill has been introduced into the legislature to incorporate the Newport Electric Car Company, with a capital stock of $100,000, with privilege of increasing it to $500,000. H. M. Healey, H. Buchanan and A. J. Parlin are the incorporators.

The Eddy Electric Manufacturing Company, formerly of Hartford, but now of Windsor, Conn., has increased its capital stock from $30,000 to $100,000. During the past eighteen months the company has piled up a surplus of $30,000, which has been capitalized for the benefit of the stockholders of record. The $40,000 additional has all been taken up, so that the concern now has a paid in capital of $100,000.

Keokuk, Iowa.—A press dispatch states that articles of incorporation of the Keokuk Electric Street Railway and Power Company were filed in the County Recorder's office on Feb. 1. The authorized capital stock is $200,000, of which $100,000 is preferred stock. The incorporators are: M. H. King, Thos. Mitchell, A. J. Chapman, H. J. Ransom and W. H. McConaughy, Des Moines and Eastern capitalists. An ordinance granting the company its charter will probably be passed at the meeting of the City Council on Monday night. It requires that six miles of track be constructed and operated by Nov. 1 of this year.

The Citizens' Rapid Transit Company, of Nashville, Tenn., has been organized and has secured the right of way from the city, county and other authorities to construct and operate a line from Nashville to the suburban manufacturing town of West Nashville, a distance of four miles. They propose to use electricity as a power, but have not yet determined upon the system to be adopted. In its selection they intend to be influenced more by merit than by the cost. They will stock the company for only $15,000 and bond it for $60,000. With this they can build, equip and provide two years' interest on the bonds. The officers are: W. H. Mitchell, president and Wm. S. Jones, secretary and treasurer

PERSONALS.

Mr. W. A. Giles, of the Mill and Mine Electric Equipment Company, of Pittsburgh, has been in New York during the past week. He is enthusiastic on the subject of electricity in mining work, and has good reasons for his faith.

Mr. E. P. Wetmore, who has done some excellent work for the Sprague Company, in this country, in the construction and operation of electric roads, will leave for Europe soon, being entrusted with the responsibility of putting in the Sprague road that has been contracted for at Florence, Italy. This will be in some respects a heavy piece of work, the road running up to 8 and 9 per cent. grades. For three or four miles of the five, it is off the flat, and there are no fewer than eighty curves. The road will be equipped with 12 cars.

Mr. Herbert Laws Webb, the assistant electrician of the Metropolitan Telephone and Telegraph Company, will read a paper before the New York Electrical Society, at Clinton Hall, this city, on February 12, at 8 P. M., entitled "Puck's Girdle Round the Earth," dealing with the laying and operation of submarine cables, and bringing out some very interesting features of the work. Mr. Webb has had considerable experience as an electrician in submarine cable work, and his paper will undoubtedly be one of great value, as well as being thoroughly popular in its manner of treatment. All interested are invited.

Mr. Bert C. Lee.—Probably the only Chinaman in pursuit of electrical knowledge in this country is Mr. Bert C. Lee, of Canton, China, who has been employed at the works of the Westinghouse Electric Company, Pittsburgh, Pa., for several weeks. Mr. Lee was sent to America at the expense of the Chinese capitalists who have contracted with the Pittsburgh firm for several large electric light plants in the Flowery Kingdom. Mr. Lee is here to study the Westinghouse alternating-current system of electric lighting, and make himself sufficiently acquainted with the apparatus to take charge of the central stations in China. Mr. Lee is a very intelligent-looking young man, and his English is also superior.

Mr. W. M. Donaldson, a very enterprising electrical engineer of Baltimore, has recently entered into the business of distributing electrical energy by means of storage batteries, and in connection with small motors, for household and office use, in the cities of Baltimore and Washington. In Baltimore his batteries are charged by the arc light wires, and in Washington by a Perret dynamo. Mr. Donaldson's business seems to prosper, judging by his recent order on the Elektron Manufacturing Company for 40 Perret motors for graphophone work. After a series of practical tests Mr. Donaldson has adopted the Perret motor for his work. In some recent tests with this motor on graphophone work, using a 2-volt battery—when recording, the motor took 2.3 ampères, and when reproducing, two ampères. With the ordinary 100 ampere-hour storage cell, the motor will drive the graphophone from 45 to 50 hours continuously, which lasts an ordinary business man one month, the battery being then replaced by a freshly charged one, and the discharged battery taken to the charging station.

MISCELLANEOUS NOTES.

The Yowell Electric Medical Co. has been incorporated at Dallas, Tex., by W. B. Henderson, Hugh McCallen, Dr. Yowell and others to establish an electric infirmary. The capital stock is $10,000.

Gas in San Francisco.—The San Francisco *Chronicle* states that during the past five years there have been over 50 deaths from gas suffocation in that city, as well as many cases not fatal. During the present year there have been five fatalities, and some action on the part of the Board of Health is deemed necessary. All this is told in less than a column.

Subway Inspectors Wanted.—An open competitive examination of applicants for appointment under the Board of Electrical Control as inspectors of electrical conductors and inspectors of underground construction will be held at Room 21, Cooper Union, on Tuesday, Feb. 11, at 10 o'clock A. M. Candidates must be residents of New York State.

BUSINESS NOTICES.

Mr. Edward F. Peck, general superintendent of the Citizens Electric Illuminating Company, Brooklyn, says that for painting electric lamps Nubian iron enamel is unequaled for durability and finish.

The National Pipe Bending Company, of New Haven Conn., has issued a very neat and effective little illustrated pamphlet describing the National feed water heater, and including a very long list of users of the apparatus.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

Eclipse Wind Engine Works.—The additions to the Eclipse Wind Engine Works, now nearly completed, will give this company a machine shop 270 feet by 70 feet and a foundry 194 feet by 72 feet The demand for machinery in their line has been so great that the works have, for nearly a year, been kept running day and night.

The Okonite Company, 13 Park Row, are distributing among their nearest and best friends a handsome thermometer, about two feet long and four inches wide, brass mounted, and with bold figuring. It is an ornament for any hall or office. Good as it is, however, and wide as its range, it gives but a faint idea of the temperature that okonite will stand.

F. S. Sterling & Co., dealers in cedar poles, etc., at Monroe, Mich., have issued a neat oblong photograph showing their pole yards with sidings from the railroad for the disposition of the material they handle. The stocks of poles shown give a good idea of the manner in which the electricians are trying to equalize conditions between the city and the forest.

The Eureka Tempered Copper Company, North East Pa., have moved into new quarters, and they are now occupying the largest building in town. It has been specially constructed for them, and is thoroughly equipped for their work in the tempered copper line. In connection with the large factory is a power plant comprising two 35 h. p. Skinner engines, by which will be operated the electric light plant for the factory and the town. The 60 h. p. boiler is from the Corry Iron Works.

Houston's Electrical Dictionary.—The New York *Herald* says of Prof. E. J. Houston's "Dictionary of Electrical Words Terms and Phrases:" "A book of this kind is absolutely necessary to the general reader who wishes to understand any modern article on applied electricity, and Mr. Houston's book seems to answer the purpose. It contains more than six hundred pages, and the definitions are often more suggestive of cyclopædia than dictionary, which is a virtue instead of a fault. The pages abound in illustrations."

Ball Engines.—The Ball Engine Company, of Erie, Pa., reports the following shipments for January: The California Electric Light Company, one 100 h. p.; Charles Black, Denver, Col., one 80 h. p.; Dayton Coal and Iron Mining Company, Dayton, Tenn., one 100 h. p.; the Okonite Company, Passaic, N. J., one 50 h. p.; Edison Electric Company, Le Grande, Ore., one 50 h. p.; B. F. Africa, Huntingdon, Pa., one 60 h. p. and one 80 h. p; Brooklyn Street Railway Company, Cleveland, O., two 125 h. p.; Central Thomson-Houston Electric Company, Somerset, Ky., one 80 h. p.; Syle & Lee, Dowagiac, Mich., one 60 h. p.; Denver Electric Illuminating Company, Denver, Col., one 80 h. p.; Waterhouse Electric Company, Baltimore, Md., one 100 h. p.; the E. S. Greeley & Co., Brooklyn, N. Y., one 35 h. p.; Owensboro Electric Light Company, Owensboro, Ky., one 80 h. p.; Laredo Electric Light Company, Laredo, Texas, one 60 h. p.; Pueblo Light, Heat and Power Company, Pueblo, Col., one 100 h. p.; Alex. Jacobs & Co., Mt. Clemens, Mich., one 100 h. p.; Brooklyn Navy Yard, one 35 h. p.; Queen City Electric Company, Cincinnati, O., one 150 h. p.; City of Tecumseh, Nebraska, one 50 h. p.

Owing to the pressure on our columns, the Patent Record has been omitted this week.